THE AUSTRALIAN
Entomologist

published by
THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND

MUSEUM VICTORIA
03 JUN 201

Volume 40, Part 2, 21 May 2013

Price: $8.00 per part

ISSN 1320 6133

THE AUSTRALIAN ENTOMOLOGIST
ABN#: 15 875 103 670

The Australian Entomologist is a non-profit journal published in four parts annually by the Entomological Society of Queensland and is devoted to entomology of the Australian Region, including New Zealand, Papua New Guinea and islands of the south-western Pacific. Articles are accepted from amateur and professional entomologists. The journal is produced independently and subscription to the journal is not included with membership of the society.

The Publications Committee

Editor:	Dr D.L. Hancock	Editorial Co-ordinator:
Assistant Editors:	Dr G.B. Monteith	Dr F. Turco
	Queensland Museum	Business Manager:
	Dr F. Turco	Dr G.B. Monteith
	Queensland Museum	(geoff.monteith@bigpond.com)

Subscriptions

Subscriptions are payable in advance to the Business Manager, The Australian Entomologist, P.O. Box 537, Indooroopilly, Qld, Australia, 4068.

For individuals:	A$33.00 per annum in Australia.
	A$40.00 per annum in Asia-Pacific Region.
	A$45.00 per annum elsewhere.
For institutions:	A$37.00 per annum in Australia.
	A$45.00 per annum in Asia-Pacific Region.
	A$50.00 per annum elsewhere.

Please forward all overseas cheques/bank drafts in Australian currency.

GST is not payable on our publication.

ENTOMOLOGICAL SOCIETY OF QUEENSLAND

Membership is open to anyone interested in Entomology. Meetings are normally held at the Ecosciences Precinct, Dutton Park, at 1.00pm on the second Tuesday of March-June and August-December each year. Meetings are announced in the Society's News Bulletin which also contains reports of meetings, entomological notes, notices of other Society events and information on Members' activities.
Enquiries relating to the Society should be sent to the Honorary Secretary, Entomological Society of Queensland, P.O. Box 537, Indooroopilly, Qld, 4068.

Cover: Our cover illustration for 2013 shows a species of the pebble-mimicking genus *Raniliella* (Orthoptera: Acrididae). There are two species in the genus, both restricted to desert environments of the northern parts of South Australia. They are commonly seen in stony areas around the Flinders Ranges. *Raniliella* is one of several genera of Australian grasshoppers which closely resemble the stones of our extensive gibber deserts. The illustration is reproduced by permission from CSIRO's *Insects of Australia* and is by the late Frank Nanninga, a Dutch-born artist who was the leading insect illustrator of the 1960s in Australia. His work reached its peak in the eight magnificent colour plates which grace the pages of *Insects of Australia.*

NOTES ON THE FEMALE COLOUR FORMS OF *SYNTHEMIS MIRANDA* SELYS, 1871 (ODONATA: SYNTHEMISTIDAE) IN NEW CALEDONIA

M. MARINOV[1] and S. RICHARDS[2]

[1]*School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand (E-mail: milen.marinov@canterbury.ac.nz)*

[2]*Conservation International, Atherton, Qld. Current address: Department of Terrestrial Vertebrates, Museum and Art Gallery of the Northern Territory, PO Box 4646, Darwin, NT 0801*

Abstract

Two female *Synthemis miranda* Selys specimens with strikingly different morphological features (mainly wing colouration) were collected in sympatry in Province Nord, New Caledonia. Both appear to be mature adults. Specimens with these two colour patterns have previously been reported in the literature but this paper presents the first record of their co-existence. We formally recognise the two forms based on colour pattern and note other morphological features that may also distinguish them. The validity of these additional characters requires confirmation through examination of further material.

Introduction

Synthemis miranda Selys, 1871 has often been referred to as the finest, most interesting and spectacular species of the genus *Synthemis* Selys (Tillyard 1910, Campion 1921, Lieftinck 1971, Davies 2002). It is also one of the most controversial species of the genus. The type locality has been extensively debated because, in the original description, Selys (1871) did not specify precisely where the female holotype originated. His statement '*Patrie*: Nouvelle-Calédonie, par feu le père Montrouzier. (Coll. Selys.)' is also misleading because it is unclear who should be credited with the discovery of the species. The situation became even more complicated when Tillyard (1910) presented an anecdote about the discovery of the species. According to him, the holotype was spotted by Selys pinned on a lady's hat in a fashion shop in Paris. The origin of this story is unclear, but most probably it was a rumour swirling around at that time and Tillyard had heard it from René Martin in Paris. However, in the two large works (Martin 1906, 1914) preceding and following Tillyard (1910), no details were given about the discovery of *S. miranda*.

Martin (1906) illustrated the wing venation and colouration of the holotype and Martin (1914) provided only a short note about the general distribution of the species (as '*Nouvelle-Calédonie*'). Ris (1915) and Schmidt (1938) commented on the validity of Tillyard's (1910) anecdote, concluding that it was erroneous and probably arose because of uncertainties about the origin of the species in the original description. However, Davies (2002) repeated this story, claiming that the species was named after its discovery in the shop in Paris and '... it was many years before its actual home was discovered to be Melanesia'. Such stories, although intriguing, do little to advance our knowledge of this species. Although the type locality is not certain and probably never will be, the general origin of the species (Nouvelle-

Calédonie) was given in the first description and its occurrence as an endemic species there has been confirmed by other researchers.

The species' wing colouration is the second most discussed point in the literature. The combination of bright yellow and brown occupying a large area of the wing gives *S. miranda* a striking appearance. Campion (1921) was the first to report that the extent of this colour is variable. Among the insects collected from New Caledonia by Mr Paul D. Montague, there were two males and three females. This material formed the basis of the description of the [met]allotype male and a brief introduction to variation in the extent of wing colouration in females. These females were collected on the same date and all had limited colour that did not extend beyond the arculus, unlike the holotype which has substantially more extensive colour on the wings. It is also important to note that one female was immature while the two others were fully mature.

Lieftinck (1971) was the next author to report females of *S. miranda* with reduced colour on the wings and the first who suggested that '... it would appear that there are two main forms of female, which differ markedly from one another as far as the wing colour is concerned, evidently quite independent from the age of the individual, intermediates occurring at the same time, though apparently more rarely'. However, no names for these forms were proposed. He did not report the total number of specimens investigated and, with the exception of seven specimens retained in the Netherlands, the material was returned to the Bishop Museum in Hawaii. Most of these seven females were collected from different locations; only two were from the same site – Pouébo, in the northeastern part of the country. One of those specimens had a wing colouration intermediate between that reported for the holotype and the reduced colour, but it is unclear to which form the second specimen from that location belongs. No further comments on this issue were presented in two subsequent studies by the same author dedicated to the Odonata of New Caledonia (Lieftinck 1975, 1976); he had examined additional imagines without specifying the type of wing colouration they possessed and regarded the wing venation (rather than colouration) as a more important taxonomic feature (Lieftinck 1976).

Reduced extent of wing colouration was reported in all 12 females that emerged during a larval rearing experiment (Winstanley 1983). No females with extensive colouration similar to the holotype emerged during that study. Davies' (2002) claim to priority of the discovery of females with reduced wing colouration is therefore incorrect. Davies (2002) referred to these specimens as 'unusual style' females but provided no specific description or a name in his otherwise very detailed review of New Caledonian odonates. Unfortunately, it is difficult to determine from Davies' illustrations the full extent of pigmentation on the wings. Apparently, he considered those females to have an atypical colouration rather than being a distinct form, although on

one occasion he observed many '... properly mature ...' individuals with this kind of colouration flying together with males. Formal description of the two female types has never been suggested in the literature and the most likely explanation is the fact that so far both types have never been collected from the same site.

A recent biodiversity survey in New Caledonia documented females with both types of wing colouration at the same location. This appears to be the first record of sympatry reported for these types and we believe it will be useful for future workers to describe and formally recognise them as distinct forms. Our morphological analysis also hinted that additional features may distinguish the 'unusual' form from the typical (*i.e.* holotype) form. The names we suggest here are provided for convenience and to help avoid any further misinterpretations pertaining to the different forms of this interesting species.

Material and methods

The material analysed here was obtained during Conservation International's Rapid Assessment Program biodiversity survey carried out around Mt Panié, New Caledonia. The study area was sampled on two occasions: 10-21 October 2010 (MM) and 01-15 November 2010 (SR). Females of the two colour forms were encountered during the second period only. They were compared with earlier descriptions in the literature, their affiliation verified using the figures provided by previous researchers and names assigned to the two forms.

Abbreviation of the wing venation follows Theischinger and Hawking (2006).

Systematics

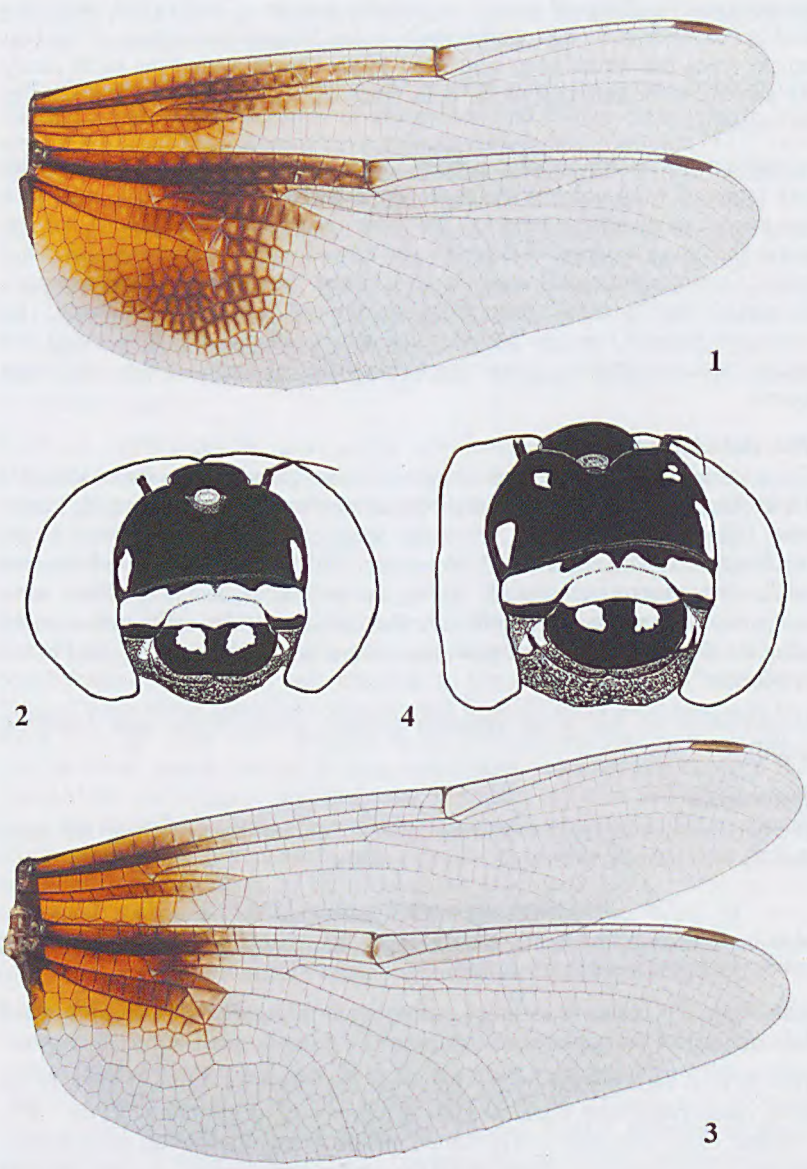
The two females reported here were collected on the same day from the same locality (see below). Both appear to be mature.

Synthemis miranda f. typica (Figs 1-2)

Material examined. NEW CALEDONIA: 1 ♀, Dawenia Camp (20°32'15"S, 164°40'50"E, 586 m a.s.l.), 15.xi.2010.

Etymology. The name is assigned according to priority of the description and does not reflect the apparent abundances of the two forms.

This form is represented by the holotype described by Selys (1871). It has been redescribed and illustrated on a number of occasions (Martin 1906, Tillyard 1910, Campion 1921), which makes a new description unnecessary. Figure 1 illustrates the extent of colour on the wings of the female reported here. The pattern is similar to that of the holotype. In addition to the extent of colouration the following features, which were not described by previous researchers, may prove useful in future for distinguishing form typica from the form described below.



Figs 1-4. *Synthemis miranda* females. (1-2) f. typica: (1) wings; (2) head. (3-4) f. extenuata: (3) wings; (4) head.

Head (Fig. 2): Mandibles reddish brown with darker colour at the bases and a white vertical bar at the level of the lateral edge of labrum. Clypeus is not whitish as given in Campion (1921). A black margin borders almost the entire postclypeus. It is broader at the anterolateral edges and central posterior area and narrows towards and along the eyes and then continues upwards along the borders with the anteclypeus, with the black bars not meeting on the very top section of this border line. A weak, roughly triangular black mark extends ventrally from the central part of posterior edge of postclypeus, with its tip pointing towards anteclypeus. Slightly darker areas are also present on the anterolateral corners of anteclypeus.

Abdomen with a pair of white ventrolateral spots present on both sides of S1 and a characteristic white ventral edge on each side of S2 to S8. Campion (1921) reported supplementary basal spots on S5, a feature not included in the original description of the holotype. They are, however, clearly visible on the specimen reported here.

Measurements (mm). Total length (with appendages) 68.7; abdomen (with appendages) 55.4; forewing length 49.4; hindwing length 48.5.

Synthemis miranda f. extenuata (Figs 3-4)

Material examined. NEW CALEDONIA: 1 ♀, Dawenia Camp (20°32'15"S, 164°40'50"E, 586 m a.s.l.), 15.xi.2010.

Etymology. The name translates from the Latin for alleviated, reduced or thinned out (H. Fliedner pers. comm.) and refers to the reduced colouration on the wing area compared with the holotype.

The most notable difference of this form is the extent of colouration on the wings. Other potentially important characters involve colouration of the clypeus, frons and abdomen but they are weakly expressed and it is not clear if they are features typical of the form or are just morphological variation. Those characters are described following the description of the wings. Other morphological features that have already been introduced in the literature were found to be nearly the same as the holotype.

Wings (Fig. 3): Tinged with brown at the bases of both pairs. The colour is deeper along the main longitudinal veins and fades on the wing membrane to opaque yellow. It is much darker in the area between Sc and R1 in both pairs of wings. In the forewings the brown area occupies the total length of the Ax6 with some patchy signs of colour in subcostal space between Ax9-10. The colouration extends posteriorly to the anal margin with the wing membrane becoming more diffuse yellow with light brownish touches along the transverse veins. The colouration occupies the entire hypertriangle and cubital space. Subtriangle is free of colour. Weak diffuse brown marks are developed along the nodus, more intensively at the proximal end of the Sc; they do not continue on the subnodus. In the hind wings the colouration is developed as follows: the subcostal space is the darkest area; opaque yellow

becomes a diffuse brownish around Ax4-5 and continues until Ax7-8; very weak patches are still present on the cells between Ax9-10 also; the colouration completely covers the sector of arculus, hypertriangle, triangle and cubital space and continues posteriorly to the level of the top rows of cells of the three divisions of the anal loop (middle to the posterior end of second row in proximal and middle divisions and only first row in the distal division); the brown continues along the anal vein up to the point where it joins CuP; weak diffused brown follows the CuP for a very short distance after this joins at about the level of the first cell formed at the division of CuP and 1A and also goes one more cell distance along 1A; nodal area is marked on the same manner as the forewings, with the brown forming an almost elliptical spot. Scattered diffused brown spots occur at several other places on the wing membrane.

Head (Fig. 4): Black colouration of clypeus generally resembles the pattern described above for f. typica but with projections into the whitish area much more marked. Two additional white spots (one divided by a transverse dark bar) are developed on the top area of the frons.

Abdomen with no supplementary basal spots on S5. The base of S5 on the single investigated female is slightly retracted into S4, which obscures clear vision of this part of the abdomen and this feature needs further verification.

Measurements (mm). Total length (with appendages) 69.3; abdomen (with appendages) 59.4; forewing length 48.3; hindwing length 47.5.

Discussion

This paper presents the first evidence for co-existence of female *S. miranda* with strikingly different wing colouration pattern and we formally refer them to two separate forms to aid future discussion of this species. Although the present descriptions are based on two females only, there are multiple data in the literature indicating that wing colouration is not related to the state of maturity and this is the first record of sympatry of the same aged (mature) females collected on the same day. Variation in the extent of wing colour was also found by Campion (1921) and Davies (2002), who reported it extending only as far as the level of arculus, which is shorter than in f. extenuata described here. Also, Lieftinck (1971) reported a specimen with colouration extent intermediate between f. typica and f. extenuata. Variations at the infraspecific level are common and were, for example, encountered in a very extensive survey on female polymorphism in Odonata (Fincke *et al.* 2005). That study reported difficulty in assigning some females to a particular form because of phenotypic variations in otherwise unequivocally andromorph and heteromorph females. They proposed that female polymorphism must be heritable in order to be considered as genetic and designated the term 'functional polymorphism' to describe genetically monomorphic females with colour states which are age dependant. It is evident, from previous

literature records and present observations, that the wing colour in *S. miranda* is not influenced by state of maturation and thus is probably inherited.

More evidence is needed to determine whether the other morphological features mentioned here as potentially diagnostic are useful because our observations are based on single specimens. Further morphological research is also necessary to determine whether the additional differences described here are age dependant, inheritable or vary between populations.

Future identification keys should consider both forms. Lieftinck (1971) provided the only key to New Caledonian species of *Synthemis* which, if followed precisely, may not identify the holotype female. It gives the wing colouration extending only as far as the arculus, which is typical of f. extenuata, whereas the dark area in f. typica extends beyond the nodus.

Synthemis miranda is a common species (Davies 2002) and future investigations will hopefully provide more data about the abundance of and ratio between the two female colour forms. The names suggested here are proposed for convenience in subsequent interpretations of the results from odonatological studies in New Caledonia. The names may not reflect the true ratio between both female forms and have no formal standing under the International Code of Zoological Nomenclature. So far it is not clear if the so called f. typica is really the typical (dominant, most common or often encountered) of the two. The name is assigned by priority as this form was the first to be described for the species. It is evident that females with both types of wing colouration are commonly encountered among the insect samples from the country. A quick scan through the literature revealed five records of f. typica and 18 records of f. extenuata. This is simply an account of the published data and in no case proves the dominance of one form over the other. Researchers do not always report on the type of females examined during their studies, nor on the number of specimens examined. For example, Lieftinck (1971) examined a large collection but reported only on a subset (six males and six females) of this material and neither Lieftinck (1975) nor Davies (2002) gave any indication of the total number of females that they examined.

Acknowledgements

We thank our local guides for providing us with the best possible assistance in the field and for kindly hosting us on their land. Our special gratitude goes to the organisers of the 2010 New Caledonia RAP, particularly to François Tron and Romain Franquet but also to the whole Conservation International-New Caledonia staff, their partner organisation Dayu Biik, and J.J. Cassan of Province Nord. We also thank Vincent Kalkman for the important suggestions and comments made on early drafts of the paper, Heinrich Fliedner for consultation on the scientific name of the newly described female form and Matt Walter for providing photos of the wing colouration.

References

CAMPION, H. 1921. Odonata collected in New Caledonia by the late Mr. Paul D. Montague. *Annals and Magazine of Natural History* **8**(9): 33-67.

DAVIES, D. 2002. The odonate fauna of New Caledonia, including the descriptions of a new species and a new subspecies. *Odonatologica* **31**(3): 229-251.

FINCKE, O., JÖDICKE, R., PAULSON, D. and SCHULTZ, T. 2005. The evolution and frequency of female colour morph in Holarctic Odonata: why are male-like females typically the minority? *International Journal of Odonatology* **8**(2): 183-212.

LIEFTINCK, M. 1971. Studies in oriental Corduliidae (Odonata) I. *Tijdschrift voor Entomologie* **114**(1): 1-63.

LIEFTINCK, M. 1975. The dragonflies (Odonata) of New Caledonia and the Loyalty Islands – Part 1. Imagines. *Cahiers O.R.S.T.O.M., Série Hydrobiologie* **9**: 127-166.

LIEFTINCK, M. 1976. The dragonflies (Odonata) of New Caledonia and the Loyalty Islands – Part 2. Immature stages. *Cahiers O.R.S.T.O.M., Série Hydrobiologie* **10**: 165-200.

MARTIN, R. 1906. Collections Zoologiques du Baron Edm. de Selys Longchamps, *Catalogue Systématique et descriptif. Cordulines. Fascicule* **XVII**: 94 pp.

MARTIN, R. 1914. Odonata. Fam. Libellulidae. Subfam. Cordulinae. *Genera Insectorum, Fascicule* **155**: 1-32.

RIS, F. 1915. Libellen (Odonata) von Neu-Caledonien und den Loyalty-Inseln. Pp 55-72, in: Sarasin, F. and Roux, J. (eds.), *Nova Caledonia. Forsdiungen in Neu-Caledonien und auf den Loyalty-Inseln, A. Zoologie*, Vol. II, L. I.

SCHMIDT, Er. 1938. Libellen als Objekte der angewandten Entomologie. Eine Literaturstudie. *Verhandlungen VII Internationaler Kongress für Entomologie, Berlin*: 1494-1505.

SELYS-LONGCHAMPS, E. de. 1871. Synopsis des Cordulines (1), 2^{me} Légion. – Macromia. *Bulletins de l'Académie Royale des sciences, des lettres et des Beaux-Arts de Belgique* (2) **31:** 519-565.

TILLYARD, R. 1910. Monograph of the genus *Synthemis*. *Proceedings of the Linnean Society of New South Wales* **35**: 312-377.

WINSTANLEY, W. 1983. Terrestrial larvae of Odonata from New Caledonia (Zygoptera: Megapodagrionidae; Anisoptera: Synthemistidae). *Odonatologica* **12**(4): 389-395.

OPETIOPALPUS SCUTELLARIS PANZER (COLEOPTERA: CLERIDAE: KORYNETINAE) ESTABLISHED IN THE WESTERN AUSTRALIAN WHEATBELT

JUSTIN S. BARTLETT[1] and ANDRAS SZITO[2]

[1]*Biosecurity Queensland, Department of Agriculture, Fisheries and Forestry (Qld), Ecosciences Precinct, GPO Box 267, Brisbane, Qld 4001 (Email: justin.bartlett@daff.qld.gov.au)*

[2]*Plant Biosecurity Entomology, Department of Agriculture and Food Western Australia, 3 Baron-Hay Court, South Perth, WA 6151 (Email: andras.szito@agric.wa.gov.au)*

Abstract

The status of the exotic clerid beetle *Opetiopalpus scutellaris* Panzer has been unclear due to the ambiguous nature of the single previous Australian record. Recent pheromone trapping at grain stores in Western Australia indicate that *O. scutellaris* is locally naturalised within the Western Australian wheatbelt. It is considered likely that the trapped *O. scutellaris* specimens originated from surrounding areas rather than being directly associated with grain.

Introduction

Corporaal (1950) listed 28 species of *Opetiopalpus* Spinola, distributed widely throughout Africa and the Palaearctic. References to the biology of this genus indicate associations with bovid manure, fungi and various plants, especially legumes, in meadows and grasslands (Bahillo de la Puebla and López-Colón 2006, Valcárcel *et al.* 2009). *Opetiopalpus scutellaris* Panzer (Fig. 1), from Africa, central and southern Europe and western Asia, has been associated with old timber (Gerstmeier 1998) and bird nests (Hicks 1959). This species was first reported in Australia from a single specimen (in Australian National Insect Collection, Canberra, ACT) from Western Australia, labelled 'Acropolis, Geraldton, G22. 22/9/76' (Kolibáč 2003).

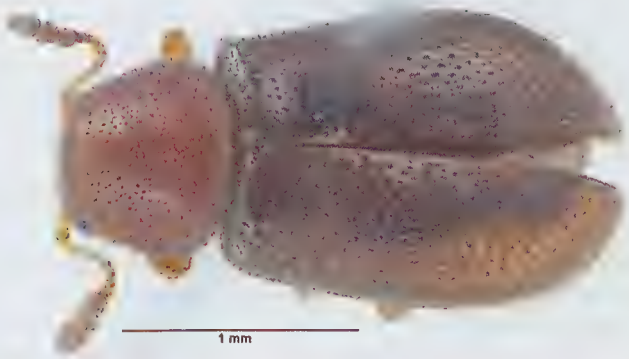


Fig. 1. *Opetiopalpus scutellaris*, specimen from Wagin, WA (in JSBC).

Discussion

The collection data of the Geraldton specimen give no clues as to the nature of its capture or whether Acropolis is a place or a freight vessel; however, as

no location 'Acropolis' has been gazetted (Geoscience Australia 2012), as a general cargo ship of that name was found to have been in service in 1976 (Cameron 2005) and as Geraldton is a port city, the latter seems most likely. In isolation, this record suggests an interception event and implies adventive status for *O. scutellaris* in Australia.

Since January 2011, numerous *O. scutellaris* specimens have been collected in traps using aggregation pheromone lures to monitor the stored product pests *Tribolium castaneum* (Herbst) (Tenebrionidae) and *Rhyzopertha dominica* (Fabricius) (Bostrichidae) near grain stores at Mingenew, Three Springs, Coorow, Koorda and Wagin in Western Australia. These recent collections provide evidence that *O. scutellaris* is locally naturalised within, and just north of, the wheatbelt region of Western Australia. It is not known whether the trapped specimens were directly associated with the grain stores, or were inhabiting surrounding areas in association with dung, timber or bird nests. Since various non grain-associated insect species were collected in the same traps and as *O. scutellaris* has not previously been reported in association with grain, the latter seems more likely. Specimens are lodged in the Dept of Agriculture & Food Collection, South Perth, WA (DAFWA), the Queensland Primary Industries Insect Collection, Dutton Park, Qld (QDPC), and in the collection of the first author (JSBC).

Acknowledgements

We thank Dave Cousins and Michelle Chami (Dept of Agriculture & Food, Western Australia) for making recently collected *Opetiopalpus scutellaris* material available and Greg Daglish (Agri-Science Queensland, Dept of Agriculture, Fisheries & Forestry) for reviewing the manuscript.

References

BAHILLO de la PUEBLA, P. and LÓPEZ-COLÓN, J.I. 2006. Los cléridos de la comunidad de Madrid (Coleoptera, Cleridae). *Graellsia* **62**(número extraordinario): 403-418.

CAMERON, J. 2005. *Acropolis - Piraeus, Greece. Great Lakes and International Ship Photograph Archives* [website]. [Accessed 9 October 2012.] Available: *http://www.wellandcanal.ca/salties/a/acropolis/acropolis.htm*

CORPORAAL, J.B. 1950. Pars 23 (Editio secunda), Cleridae. In: Hinks, W.D. (ed.), *Coleopterorum Catalogus Supplimenta*. W. Junk, The Hague.

GEOSCIENCE AUSTRALIA. 2012. *Gazetteer of Australia Place Name Search* [website]. [Accessed 9 October 2012.] Available: *http://www.ga.gov.au/place-names/*

GERSTMEIER, R. 1998. *Checkered beetles. Illustrated key to the Cleridae of the Western Palaearctic.* Margraf Verlag, Weikersheim.

HICKS, E. A. 1959. *Check-list and bibliography on the occurrence of insects in birds' nests.* Iowa State College Press, Ames.

KOLIBÁČ, J. 2003. A review of Australian genera of Korynetinae (Coleoptera, Cleridae). *Entomologica Basiliensia* **25**: 41-97.

VALCÁRCEL, J.P., PILOÑA, F.P. and RUIZ-TAPIADOR, I. 2009. Sobre la presencia de *Opetiopalpus bicolor* (Laporte de Castelnau, 1836) (Coleoptera, Cleridae) en lahunas de Espana Central. *Arquivos Entomolóxicos* **1**: 17-21.

AERIAL BROOD CELLS CONSTRUCTED BY SOME AUSTRALIAN RESIN BEES (HYMENOPTERA: MEGACHILIDAE) AND A CASE OF GREGARIOUS NESTING

TERRY F. HOUSTON[1] and DAVID T. PIKE[2]

[1]*Department of Terrestrial Zoology (Entomology), Western Australian Museum, Locked Bag 49, Welshpool Delivery Centre, WA 6986 (Email: Terry.Houston@museum.wa.gov.au)*

[2]*37 Everingham St, Carine, WA 6020*

Abstract

This paper brings together a number of observations and photographs of 'aerial' (*i.e.* free-standing and exposed) resin brood cells constructed by Australian *Megachile* Latreille species. The cells were attached either singly or in groups to dead twigs on shrubs, standing grass flower stalks and the underside of a rock. In southwestern Australia, at least two species are known to build cells attached to dead woody twigs. Three females of one of these species were observed constructing and provisioning cells at the same time in close proximity on the same twig, thus suggesting gregarious nesting. The selection pressures which may have led to resin bees constructing such exposed and seemingly vulnerable brood cells are discussed briefly.

Introduction

The world-wide family Megachilidae is comprised of essentially solitary bees and its largest genus *Megachile* (*sensu* Michener 2007) is notable for transporting material to its nesting sites for use in nest construction. This material includes resin, leaf mastic, leaf or petal pieces, plant hairs, mud and pebbles. Megachiline bees lack the basitibial and pygidial plates characteristic of burrowing bees and many species (but certainly not all (Eickwort *et al.* 1981)) use preformed cavities such as beetle borer holes in dead wood or the vacated nests of mud wasps in which to build their brood cells. Such species are often referred to as 'lodger bees'. Female resin bees usually apply their loads of resin to the walls of their nesting cavities so that the cavity, to a large extent, determines the shape of the cells. Only partitions built across the lumens of cavities to close off individual cells or to seal nest entrances could be termed 'free-standing'. Here, we report a very different mode of nest construction, where cells are built in exposed situations and are almost completely free-standing. Our observations and photographs were recorded over many years at various localities in Western Australia and South Australia. Only in some cases were bees taken with these cells but probably all were the work of *Megachile* species.

Taxonomy and identification

The identification of many Australian resin bees, such as those discussed in this paper, is fraught with difficulty. First, their generic-level classification has changed several times over the years and remains in a state of flux. Many species were established in the genus *Megachile* Latreille (*e.g.* Cockerell 1930) but Michener (1965) transferred some of them to the genus *Chalicodoma* Lepeletier (leaving *Megachile* for those megachilids that cut leaves) and he recognized several subgenera. Much later, in his major work on the bees of the world, Michener (2000, 2007) returned the resin bees to the

genus *Megachile* because of the presence of taxa with features intermediate between those of *Megachile* and *Chalicodoma*. More recently, Gonzalez (2008) made a case for separating some resin bees from both *Megachile* and *Chalicodoma* and proposed that they be placed under the oldest available generic name, *Thaumatosoma* Smith. As we are uncertain as to whether this move will gain general acceptance, we have preferred here to follow Michener's (2007) scheme of classification and nomenclature. Second, the Australian resin bees have not been completely revised. King (1994) commenced a revision of the Australian *Chalicodoma* (*sensu* Michener 1965) but has not extended it to the subgenera most relevant to the bees discussed here. Further difficulties are outlined below under 'Identification of associated bees'.

All bee specimens and nests collected in the course of this study are lodged in the entomology collection of the Western Australian Museum.

Observations

Cases ## 1-3

Three clusters of aerial resin brood cells were found on different occasions by one of us (DTP) in Star Swamp Reserve, North Beach (a suburb of Perth), Western Australia. This is an area of remnant bushland comprising mainly Banksia woodland with emergent Tuart (*Eucalyptus gomphocephala*) trees and a floristically diverse understorey of shrubs and herbs. One of the clusters (case #2) was found in an established native garden in the grounds of the Henderson Environment Centre on the western side of the Reserve.

All cells were oriented with their long axes more or less vertical and their mouth ends uppermost. They attached to horizontal dead twigs at or very close to their proximal (mouth) ends and hung mostly below them. All clusters would have been exposed to the sun for most of the day. Female bees (apparently of the same species) were observed working on two clusters but not the third. However, the similarities of the clusters and their occurrence in the small bushland reserve suggest that all were the work of the same species.

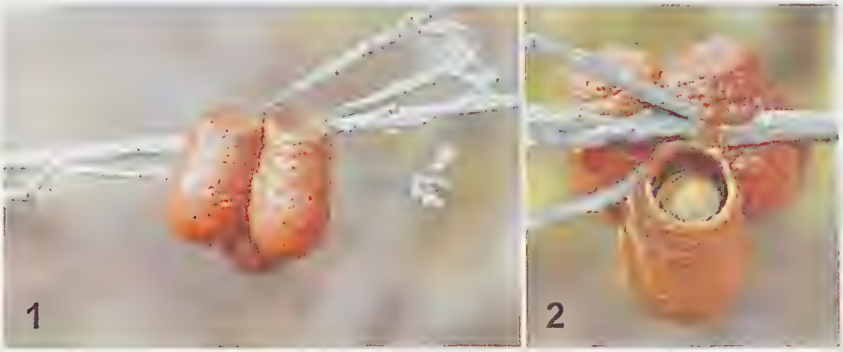
Case # 1

A cluster of three cells (Figs 1-2) was found on 25 November 2006. They were attached near the end of a dead twig of *Melaleuca systena* almost 1 m above ground. Two sealed cells were on one side of the twig and an open cell was on the other, each cell being in contact with its neighbours. A female bee was observed working in the open cell (Fig. 2).

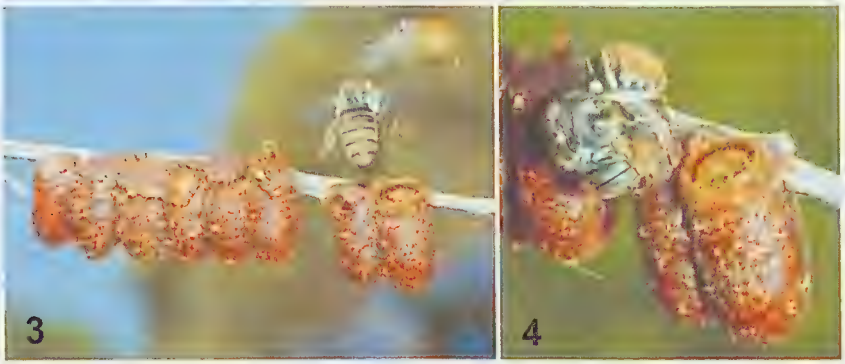
Case # 2

A group of eight cells (Figs 3-4) was found on 28 February 2009 in the Henderson Environment Centre garden. The cells were arranged in a linear series on a dead horizontal twig protruding from an otherwise healthy *Olearia axillaris* and were about 1 m above ground. All cells were attached

to the same side of the twig at their upper (mouth) ends and were in contact except for a gap between the sixth and seventh (counting from the left in Fig. 3). Five cells were sealed and three were open (fourth, seventh and eighth). Three females were active at the cluster. One, seen carrying pollen in Fig. 3, was provisioning cell # 8 while another was busy capping cell # 7 (Fig. 4).



Figs 1-2. Case # 1: cluster of three cells from Star Swamp Reserve, North Beach, WA, viewed from two sides. The abdomen of a female is visible in the open cell in Fig. 2. Photos: David Pike.



Figs 3-4. Case # 2: group of eight cells found in a native garden on the edge of Star Swamp Reserve, North Beach, WA. (3) five cells were sealed and three (4^{th}, 7^{th} and 8^{th} from left) were open; two females, one loaded with pollen, hover over the cluster; (4) closer view showing female constructing cap on 7^{th} cell and another female in 8^{th} cell. Notice pale inclusions in resin. Photos: David Pike.

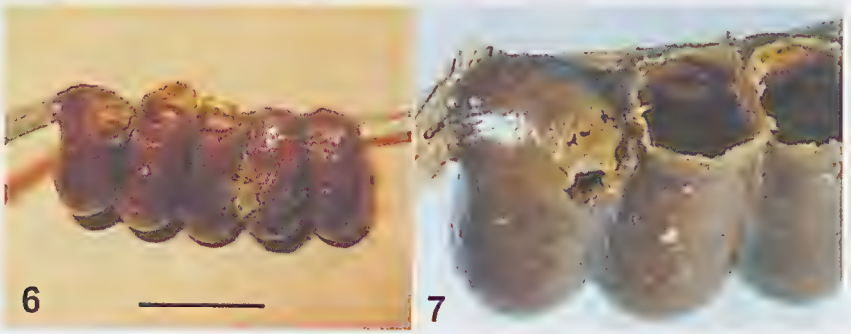
Case # 3

A cluster of eleven cells attached to a dead horizontal twig (Fig. 5) was found on 16 November 2009. The cells occupied both sides of the twig and each was in contact with one or more neighbouring cells. The pale material coating the cells was not identified but may have been soil. No bees were observed with this cluster.

Fig. 5. Case # 3: a cluster of 11 cells photographed at Star Swamp Reserve, North Beach, WA. Photo: David Pike.

Case # 4

A cluster of five cells (Figs 6-7) was found by DTP in his home garden in the Perth suburb of Carine on 13 February 2012. The cells were attached to one side of a dead, horizontal twig of a *Tecoma* plant and would have been exposed to the sun for most of the day. The twig was 1.0-1.5 mm in diameter and about 20 cm above ground. Each cell was attached at its upper (mouth) end and hung below the twig and each was fused to one or two of its neighbours. The cells were 9-10 mm long and *c.* 5 mm in diameter (the group measuring 24 mm in width). Externally, they were smooth and shiny, the resin walls containing only a few small, pale inclusions. Three cells (first to third from left in Fig. 6) were open and, because of the presence of cocoons, must have yielded adult progeny. The remaining two cells were sealed and, when opened two days after discovery, each was found to contain a newly eclosed adult female within a cocoon.



Figs 6-7. Case # 4: a five-cell cluster found in a suburban garden in Carine (Perth), WA. (6) three cells on the left were vacated (cocoons were present) but two others were sealed and contained newly eclosed females (scale bar = 1 cm); (7) enlarged view of the three vacated cells showing their relatively smooth, shining surfaces with few inclusions.

The cap of each cocoon was comprised of multiple layers of coarse, criss-crossing, pale brown, silk threads. The remainder of the cocoon was membranous, colourless and transparent and closely applied to the inner walls of the cell. Clearly visible beneath this membrane was a thin layer of faecal material, laid down as longitudinal ribbons. These obscured the underlying resin walls except at the base of the cell. Microscopic examination of the faeces revealed that they were composed of a single kind of pollen grain consistent in morphology with those of Fabaceae.

Case # 5

This single cell (Fig. 8), collected by Geoff Allen at Cape Naturaliste, WA in December 1993, was donated to the Western Australian Museum along with a female *Megachile* (registered WAM #17621). The cell and its maker had been collected at night. The incomplete cell, measuring 9 mm in length and 5.5 mm in maximum diameter, was attached to a dead twig *c.* 1.5 mm in diameter. The cell was attached at its mid section (in contrast to cells in cases ##1-4) but its original orientation is unknown. It was constructed from pale, yellow-brown, translucent resin and revealed distinct annulations at its proximal (mouth) end. It had been partly provisioned with pollen. The pollen consisted of one kind of grain: spherical, tricolpate and finely sculptured.

Fig. 8. Case # 5: a cell from Cape Naturaliste, WA, collected in December 1993 by G. Allen.

Case # 6

A series of ten cells attached to a dead horizontal twig (Fig. 9) was photographed by Jean Hort, 5.7 km north of Calingiri, *c.* 120 km NE of Perth, on 8 April 2010. The twig, extending from a shrub of *Daviesia angulata*, was *c.* 80 cm above ground in an exposed situation. The habitat was degraded, regrown native vegetation between a road and a railway. Each cell was attached by its upper (mouth) end and well separated from its neighbours. All cells were sealed and no bees were observed on or about them.

Fig. 9. Case # 6: a series of ten cells found near Calingiri, *c.* 120 km NE of Perth, WA. Photo: Jean Hort.

Case # 7

Two cells attached to a vertical, standing flower stalk of 'spinifex' (*Triodia* sp.) (Fig. 10) were found by TFH *c.* 30 km S of Mount Bruce, Karijini National Park, Hamersley Ranges, WA, on 10 May 1980. The lower cell was opened, revealing a pharate adult within. This specimen was clearly a *Megachile* but could not be identified to subgenus.

Case # 8

Two series of seven and nine cells, respectively, were found attached to the underside of a rock at Peake Homestead ruins, *c.* 73 km SE of Oodnadatta, South Australia, by TFH in April 1977. The cells had been vacated and the maker was not determined. All cells were attached to the rock by one side, were in contact with one or two neighbouring cells and faced in the same direction (Fig. 11). Cell length was estimated to be *c.* 8.5-9.0 mm.

Fig. 10. Case # 7: two resin cells attached to a flower stalk of 'spinifex' (*Triodia* sp.) in Karijini National Park, northern Western Australia. (Match length *c.* 43 mm). Part of lower cell was cut away revealing a pharate adult within.

Identification of associated bees

Females were photographed working on some of the Star Swamp cells (cases ## 1-2), taken as unemerged progeny from two Carine cells (case # 4), and a female was collected with the Cape Naturaliste cell (case # 5). Only a pharate adult was observed within one of the cells in case # 7. No bees were observed in the remaining cases.

Fig. 11. Case # 8: two series of cells attached to the underside of a rock at Peake Homestead ruins, *c.* 73 km SE of Oodnadatta, SA. Scale is provided by the match (length *c.* 43 mm) and a bushfly (upper left).

The females from the Carine cells (case # 4: Figs 12-14) appeared to be conspecific with the females appearing in Figs 2-4 (cases ## 1-2). The diffuse orange tomentum over the dorsum of the metasoma and the prominent white 'hair' spot on each side of the first metasomal tergum are distinctive. Other features which set this species apart from most other Western Australian resin bees are the following: dense white pubescence forming seven spots on thorax (pronotum with one median and two lateral spots; mesoscutum with an anterior paramedian pair and a posterolateral, preaxillary pair); a line of beige tomentum on posterior margin of mesoscutum; clypeus unmodified except for a small median notch and tubercle in ventral margin; mandibles with short tufts of orange setae on outer surfaces subapically (Fig. 14). A specimen in the Western Australian Museum (WAM 22533), possessing all of these character states and identified as an unnamed species of *Austrochile* Michener (det. J. King), appears to be conspecific. It was collected 103 km west of Neale Junction, Western Australia, on 21 September 1982, by T. F. Houston and B. P. Hanich on flowers of *Swainsona* (Fabaceae). It was assigned WAM bee species code F437.

Figs 12-14. Female *Megachile* reared from one of the Carine cells (case # 4). (12) dorsal view; (13) lateral view; (14) facial view. Arrows indicate characteristic setal tufts on mandibles.

The female collected with the cell from Cape Naturaliste (case # 5) is almost identical to those from North Beach and Carine (cases ## 1-4) but differs as follows: metasomal terga lacking a general covering of orange tomentum; T2-4 with complete apical bands of white tomentum; T5 with scattered white

plumose setae; T6 sparsely covered with ochreous setae. These differences suggest that it is a distinct species and the specimen (WAM 17621) has been assigned species code F473.

The subgeneric placement of the two species associated with cases ## 1-4 and # 5 must remain in doubt until a revision of *Austrochile* and/or *Hackeriapis* Cockerell *sens. lat.* is undertaken. None of the females exhibits a clear spine on the first metasomal tergum (a diagnostic feature of *Austrochile*) and, unfortunately, we are unaware of any conspecific male specimens that might help decide on the species' subgeneric placement.

Subsequent to acceptance of this paper, one of us (TFH) reared adults of both sexes from a series of 11 cells found in the Perth suburb of Hamersley. Females matched those reared from the Carine cells (case # 4). Males possess diagnostic features of *Megachile* (*Austrochile*) but, at this time, do not assist species identification (J. King pers. comm.).

A potential maker of the kind of cells reported in case # 8 was found in the WAM collection: a female (WAM 22535) labelled as an undescribed species of *Austrochile* by J. King and collected at Woomera, South Australia, 15 September 1968 by H. Mincham, carries a label stating that it was 'constructing resin cell in cliff face'. With it is a conspecific female (WAM 22532) taken 70-75 km ENE of Norseman, WA. While similar in size and several features to species F437 from Carine and North Beach, these specimens lack white spots of tomentum on the pronotum and mesoscutum and almost certainly represent a distinct species (coded F436).

Discussion

Some different methods of construction can be deduced among the different cases reported here. In cases ## 1-4, construction must have begun with the 'mouth' of the cell and, in case # 5, with the middle section, given the different points of attachment to the twig. Also, in cases # 1 and # 5 the cells have distinct annulations towards the mouth end but no annulations were evident in other cells. External finishes of cells in the various cases varied from smooth and glossy to rough and dull. Some variation among the finishes of the Star Swamp and Carine cells (cases ## 1-4), believed to have been made by the one species, could be explained, perhaps, by use of resin from different sources.

While adult bees were collected or observed with brood cells in only four of the eight cases described above and appeared to represent just two species, the variety of cell forms and arrangements suggest that the eight cases may represent the work of at least five species: (Sp. 1) the Star Swamp and Carine cells (cases ## 1-4); (Sp. 2) the Cape Naturaliste cell (case # 5); (Sp. 3) the Calingiri cells (case # 6); (Sp. 4) the Karijini cells (case # 7); (Sp. 5) the Peake Homestead cells (case # 8).

Aerial brood cells are constructed by numerous kinds of apocritan wasps, including some Sphecidae, Crabronidae, Pompilidae and Vespidae (Evans and Eberhard 1970, Gess 1996), and by various bees (many Megachilidae and some Apidae in the tribes Euglossini, Bombini and Apini (Michener 2000, 2007)). Mud is used by the majority of the aerial nesting wasps and by species of *Chalicodoma sensu stricto.* Resin is used only rarely by wasps (*e.g.* Rayment 1935, Mudd and Corbet 1975) and bees other than megachilids (mainly Apidae: Euglossini, Meliponini and Apini, and in combination with secreted wax in the last two tribes (Michener 2000, 2007)). The habit of building aerial cells or nests appears to have arisen independently in these various hymenopteran families and multiple times in some of them. Aerial nesting is generally believed to have evolved from cavity nesting which, in turn, evolved from ground nesting. In Megachilidae, aerial nesting has been reported in some genera of Anthidiini and Osmiini and in one subgenus (*Megachile* (*Chalicodoma*)) in Megachilini (Eickwort *et al.* 1981, Michener 2007). It should be noted that Anthidiini are represented in Australia by only two species known only from Queensland and New South Wales [including the recently established *Afranthidium repetitum* Schultz], while Osmiini and *Chalicodoma sensu stricto* are not represented in Australia (Michener 1965, 2007). Aerial nesting has not previously been reported for any of the Australian Megachilini. Doubtless, the cases we describe here represent a further instance (or instances) of independent evolution of aerial nesting habits.

To account for multiple origins of aerial nesting among wasps and bees there must be one or more selection pressures favouring this style of nesting. Perhaps the most likely advantage would be that the bees are less constrained in where they can nest. There could be considerable competition among cavity nesting wasps and bees (and other insects) when few suitable cavities are available. Aerial nesting females could therefore expend less time and energy searching for a suitable nesting site and more on building brood cells. Whatever the benefits of aerial nesting, they must be considerable to outweigh new risks from exposure to physical damage from storms, bird attack, extremes of temperature, bush-fires and parasitoids. When cells are open during provisioning, they would be especially vulnerable to water entry during rain and attack by depredators and parasitoids.

Case # 2 was especially interesting in that three females were observed building and provisioning cells concurrently on the same twig. While gregarious nesting is common among many solitary, ground nesting bees, it occurs only rarely among cavity nesting or 'lodger' bees. The latter are, of course, confined to nesting in the available cavities in their environments. Gregarious nesting, therefore, is a rarity among the Megachilidae and has been reported previously for very few species. Females of the American *Dianthidium sayi* Cockerell (Anthidiini) build cells of resin and other materials attached to roots in cavities in the soil and colonies of from 8 to 50

or more nesting females have been reported (Custer and Hicks 1927). The females excavate their own nesting cavities and so are not constrained by availability of pre-existing hollows. Females of *Afranthidium repetitum* are known to have constructed a mass of *c.* 1750 cells from plant hairs in a man-made box (Michener 2000, 2007). We can see here that when lodger bees change to aerial nesting they gain another benefit – the potential to nest gregariously, when defence of the brood cells can be shared among a number of females. With gregarious nesting, too, comes the potential for development of higher levels of sociality.

Acknowledgements

We thank Jean Hort of Stratton, Perth, for permission to use one of her images (Fig. 9) and for associated information. Victor Gonzalez (Natural History Museum, University of Kansas) kindly read an early draft of this paper and offered constructive suggestions for its improvement.

References

COCKERELL, T.D.A. 1930. The bees of Australia. Megachilidae. *The Australian Zoologist* **6**(3): 205-236.

CUSTER, C.P. and HICKS, C.H. 1927. Nesting habits of some anthidiine bees. *Biological Bulletin* **52**(4): 258-277.

EICKWORT, G.C., MATTHEWS, R.W. and CARPENTER, J. 1981. Observations on the nesting behavior of *Megachile rubi* and *M. texana* with a discussion of the significance of soil nesting in the evolution of megachilid bees (Hymenoptera: Megachilidae). *Journal of the Kansas Entomological Society* **54**(3): 557-570.

EVANS, H.E. and EBERHARD, M.J.W. 1970. *The wasps.* David & Charles (Holdings) Ltd, Newton Abbot, England.

GESS, S.K. 1996. *The pollen wasps, ecology and natural history of the Masarinae.* Harvard University Press, Cambridge, Massachusetts and London, England.

GONZALEZ, V.H. 2008. Phylogeny and classification of the bee tribe Megachilini (Hymenoptera: Apoidea, Megachilidae), with emphasis on the genus *Megachile*. *ProQuest UMI Dissertation Publishing* 1-274.

KING, J. 1994. The bee family Megachilidae (Hymenoptera: Apoidea) in Australia. I. Morphology of the genus *Chalicodoma* Lepeletier, and a revision of the subgenus *Hackeriapis* Cockerell. *Invertebrate Taxonomy* **8**(6): 1373-1419.

MICHENER, C.D. 1965. A classification of the bees of the Australian and South Pacific Regions. *Bulletin of the American Museum of Natural History* **130**: 1-362.

MICHENER, C.D. 2000. *The bees of the World.* The Johns Hopkins University Press, Baltimore.

MICHENER, C.D. 2007. *The bees of the World.* 2nd edition. The Johns Hopkins University Press, Baltimore.

MUDD, A. and CORBET, S.A. 1975. Use of pine resin in nests of pemphredonine wasps. *Transactions of the Royal Entomological Society of London* **127**(3): 255–257.

RAYMENT, T. 1935. *A cluster of bees.* Endeavour Press, Sydney.

KANALIELLA GEN. N., A NEW GENUS OF CLERIDAE FROM THE MELANESIAN REGION (COLEOPTERA: CLERIDAE: CLERINAE)

ROLAND GERSTMEIER and MARTIN SEITNER

Technische Universität München, Department Ökologie und Ökosystemmanagement, Lehrstuhl für Tierökologie, Hans-Carl-von-Carlowitz-Platz 2, 85350 Freising, Germany (E-mail: r.gerstmeier@googlemail.com; martin.seitner@mytum.de)

Abstract

Kanaliella dregei (Perroud, 1864), comb. n. and *Kanaliella triangularis* (Perroud, 1864), comb. n., from the Melanesian territories of New Caledonia and Vanuatu, are transferred from *Eunatalis* Schenkling, 1909 to the new genus *Kanaliella* Gerstmeier, gen. n. and lectotypes designated. Colour photographs, figures of genitalia and distribution maps are provided.

Introduction

Schenkling (1909) erected *Eunatalis* Schenkling for Australian clerid species formerly included in the South American genus *Natalis* Laporte. Kolibáč (1998) synonymised *Metademius* Schenkling, *Eunatalis* Schenkling and *Cormodes* Pascoe with *Natalis*, although Solervicens (2007) disputed this and reinstated *Metademius* and *Eunatalis* as valid genera without commenting on the status of *Cormodes*. In his cladogram, Solervicens (2007) showed the relationships between the South American genera *Eurymetomorphon* Pic, *Neogyponyx* Schenkling and *Natalis* with the Australian genera *Metademius* and *Eunatalis*. Further assessment of these genera is required in order to clarify their taxonomic status.

When revising *Eunatalis* (Gerstmeier and Seitner in press), it became evident that a new genus was required for the Melanesian species *Eunatalis dregei* (Perroud) and *Eunatalis triangularis* (Perroud). *Kanaliella* Gerstmeier gen. n. is herein established, based on differences of elytral punctation/striation, anterior mesoventral process, protibiae and hindwing venation (see genus diagnosis below).

Material and methods

This study is based on 37 specimens from 8 museums and institutional collections. Lectotypes are designated in order to fix the taxonomic identities of the species involved. Museum acronyms and curators are as follows:

BMNH – Natural History Museum, London, UK (Beulah Garner, Max Barclay); HNHM – Hungarian Natural History Museum, Budapest, Hungary (Otto Merkl); IAC – Institut Agronomique néo-Calédonien, La Foa, New Caledonia (Christian Mille); ISNB – Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (Pol Limbourg); MNHN – Museum National d'Histoire Naturelle, Paris, France (Thierry Deuve, Antoine Mantilleri); RGCM – Roland Gerstmeier Collection, Munich (deposited in the collection of the Technical University Munich); SDEI – Senckenberg Entomologisches Institut, Müncheberg, Germany (Lutz Behne); QMB – Queensland Museum, Brisbane, Australia (Susan Wright).

From all examined specimens the label data were transcribed and presented at the beginning of each species description. The depository of the specimen is given in parentheses.

The taxonomic changes herein are based only on morphological studies, including preparations of the male genitalia, the pygidium and the sixth ventrite. For this purpose the specimens were heated in distilled water and the genitalia removed with fine forceps through small incisions made along the sides of the terminal abdominal segments. Aedeagi were cleaned of soft tissue in 10% KOH, cleared in 70% ethyl alcohol and submerged in glycerine, then stored in genitalia vials pinned below each specimen.

Measurements were made under a stereo microscope using an ocular micrometer. Total body length is the distance measured from the apical clypeal margin to the elytral apices. Elytral length was measured alongside the elytral suture and pronotal length was taken from the dorsal middle line. Pronotal width was measured at the broadest extreme. Measurements of the elytral width were made across the middle. The scale bar is 1 mm (except as noted otherwise).

Habitus photographs of adult beetles were taken using a DFC 490 digital camera fitted to a Leica Z6 stereo microscope, then composited with Leica LAS 3.8 automontage software.

Plot points of distribution maps were made with QuantumGIS (1.8.0) and are based on locality data sourced from specimen labels. These data included exact locality information based on longitude/latitude coordinates. Red labels were applied to newly designated lectotypes and paralectotypes.

Kanaliella Gerstmeier, gen. n.

Type species: *Natalis dregei* Perroud, 1864.

Diagnosis. In *Kanaliella* gen. n. the elytral punctation in the basal part (up to middle) is arranged into ten striae (in *Eunatalis* the 9th stria is represented by distinct punctation near the apex in some species only), the punctation is without nodules (*Eunatalis* with two or three nodules), the anterior mesoventral process is lacking the central excavated area (in *Eunatalis* slightly open), the distal margin of the broadly dilated pro-intercoxal process is thick and bulging (not bulging in *Eunatalis*), the protibial spine (short apical apophysis) is absent (*Eunatalis* with spine), the hind wings are missing the MP3+4 (*Eunatalis* with short MP3+4), and the apical field is about one-third of the elytra (in *Eunatalis* less than one-third).

Head: Labrum broadly emarginate, V-shaped; terminal maxillary palpomeres with sides parallel to very weakly divergent and apex obliquely truncate, terminal labial palpomeres securiform; eyes coarsely facetted, protruding laterally, margined, strongly ovate; interocular space about 2-2.5 eye widths (as viewed from above); head including eyes as broad as or broader than

anterior width of pronotum; gular sutures converging, gular process conspicuous, with two papillae. Epistomal suture distinct. Antennae with 11 antennomeres, filiform; antennomeres with dense, fine punctation, terminal three antennomeres densely tomentose, forming a loose club.

Thorax: Pronotum longer than wide, sides more or less sinuate, with wrinkles, middle with an elongated groove (sometimes missing or weak); sub-basal collar distinct, grooves of sub-basal collar fused or separated by an indistinct bar. Pro-intercoxal process narrow, broadly dilated distally, distal margin thick and bulging (Fig. 1); procoxal cavities posteriorly closed; anterior mesoventral process distinct, sinuate, closed apically (Fig. 2); metaventrite with a conspicuous discriminal line. Metendosternite with conspicuous furcal arms; laminae acute, triangular (Fig. 3).

Elytra: Elytral base not margined, lateral margins parallel or broadest behind middle, apices broadly rounded, elytral punctation arranged into ten striae, interstices with a conspicuous microsculpture (wrinkled); punctation without nodules. Hind wing with closed wedge cell, margin of radial cell strongly sclerotized, MP3, MP4, AA3+4 and CuA+AA reaching margin, MP3+4 and RP2 absent (Fig. 4).

Legs: Inner edge of protibiae and sometimes mesotibiae with a row of short, thick bristles, with more or less conspicuous punctation and fine wrinkles; profemora conspicuously swollen, protibiae slightly bent, mesotibiae slightly bent or straight, metatibiae straight, all tibiae without longitudinal carinae, protibiae terminating in a single spur (without a spine), tibial spur formula 1-2-2; tarsal pulvillar formula 3-3-3, tarsal pulvilli broadly lobed, lobes not emarginate; claws simple.

Abdomen: Six abdominal ventrites.

Etymology. The name *Kanaliella* refers to Kanala, the New Caledonian type locality of the two species.

Redescription of the species

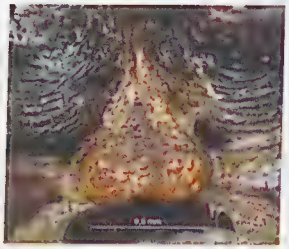
***Kanaliella dregei* (Perroud, 1864), comb. n.**

(Figs 5, 7, 9)

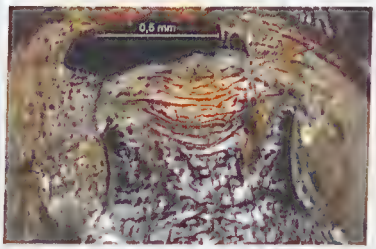
Natalis dregei Perroud, 1864: 108; Fauvel 1904: 144.

Type material examined. Lectotype ♂ (designated here): NEW CALEDONIA. *dregei* Perroud, Kanala, nov. cal.; ex coll. Perroud; type (MNHN). Paralectotype (designated here): Coll. R. I. Sc. N. B., Nouvelle Calédonie, Kanala, Fevrier rec. Montrouzier, ex coll. Fauvel; Coll. A. Fauvel *Natalis triangularis* Perr. 1864; Syntype (ISNB).

Additional specimens. NEW CALEDONIA: 2 ex., Nova Caled. (MNHN). Bourail (MNHN). Nov. Caledon. Fairmaire; *Natalis dregei* Perr.; *Eunatalis dregei* Perroud, 1985 Ginter Ekis det. (MNHN). Noumea, N. Caledonie; *Natalis dregei* Perr.; desire (MNHN). La Foa (MNHN). Yahoué; *dregei* Perroud (RGCM). Nouvelle Caledonie (RGCM). New Caledonia, Maré, sifted, 25.v.-6.viii.1987, leg. János Balogh (RCGM).

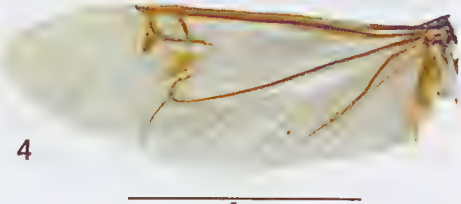


1

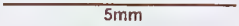


2

3



4



5

6

Figs 1-6. *Kanaliella* gen. n. (1) pro-intercoxal process (Scale bar 0.5 mm); (2) anterior mesoventral process (Scale bar 0.5 mm); (3) metendosternite (Scale bar 1 mm); (4) wing venation (Scale bar 5 mm); (5) habitus *K. dregei*; (6) habitus *K. triangularis* Lectotype.

2 ex. New Caledonia, Maré, *Araucaria* forest, beaten, 25.v.-6.viii.1987, leg. János Balogh (HNHM). Nouvelle-Calédonie, Farino/Barbou L. Face á la scierie Alt. 305 m; Collecte sur: *Codiaeum peltatum* abattu Le 22/03/05 Par S. Cazères & C. Mille (IAC). Nouvelle-Calédonie, Farino/Barbou L. Ensemble de la propriété; Collecte sur: Divers par battage Le 22/03/05 Par S. Cazères & C. Mille (IAC). Nouvelle-Calédonie, Sarraméa, Col d'Amieu; Collecte sur: Divers Le 21 et 23/11/05 Cazères & Nugues (IAC). Sarramea: N-Caledonie, Reserve du Col d'Amieu le 17/03/07 par T. Salesne. Amp. Vap. Mercure (IAC). VANUATU: Brazier; New Heb; Schenkling det; Brit.Mus. 1907; *Eunatalis dregei*, Ginter Ekis det. 1995; Col-02942 (SDEI). 46302; Brazier; New Heb; Fry Coll. 1905-100; *Natalis dregei* Montrz.; *Natalis dregei* Montr. S. Schenkling det. (BMNH).

Description. Length: 10-13.7 mm (19 specimens measured). Head: Black with isolated pilosity, dense punctation and wrinkles and a more or less conspicuous longitudinal fovea between the eyes; eyes separated by about 2.1-2.5 eye widths.

Thorax: Pronotum black with light brown to black pilosity; sides rounded then divergent before the anterior margin, widest behind middle, constricted basally; surface with large and small punctation, wrinkles on basal half laterally and dorsally and around central longitudinal fovea; grooves of sub-basal collar fused, flattened; pronotal length to width ratio 1.06-1.15:1. Scutellum triangular, dark brown to black with isolated pilosity and dense punctation. Thoracic ventrites black with isolated pilosity; anterior mesoventral process lacking deeply sculptured process; mesoventrite finely wrinkled; posterior part of mesepisternum with isolated punctation.

Elytra: Elytral length to width ratio 2.35-2.45:1; elytra dark brown to black, with isolated pilosity, with a sharply S- to Z-shaped fascia in the middle of most specimens which spans from the suture to the lateral margin and is often broken before the lateral margin, the fascia formed of thick golden setae; elytral base slightly broader than pronotum, sides broadening towards apex; punctation very large, deep and irregularly-shaped (sub-aereolate) to apical two-fifths internally and apical quarter externally; apical area smooth in part with irregular, shallow, elongate impressions; punctation conspicuously wider than interstices, becoming flattened and slightly decreasing towards apex; punctation of ninth and tenth striae conspicuous towards apex; interstices with fine wrinkles, not ridged.

Legs: Black with short dense pilosity, dense punctation and fine wrinkles; protibiae slightly bent, mesotibiae straight.

Abdomen: Abdominal ventrites brown to black, some specimens with a yellowish-coloured posterior margin; tegmen opened ventrally, phallic tip Z-shaped (in side view), with a hook-like structure; length of phallobase in relation to whole tegmen about 50%, lateral sclerotization of phallobase distinct, but not strong, apical lateral sclerotization of parameres weak, V-shaped branches of ventral sclerotization distinct; spicular fork fused less

than one-fifth its length; sixth ventrite long, slightly and broadly emarginated; pygidium compact, straight, processes short, stout (Fig. 7).

Distribution. New Caledonia (including Isle of Pines and Mare, after Fauvel 1904) and Vanuatu (Fig. 9).

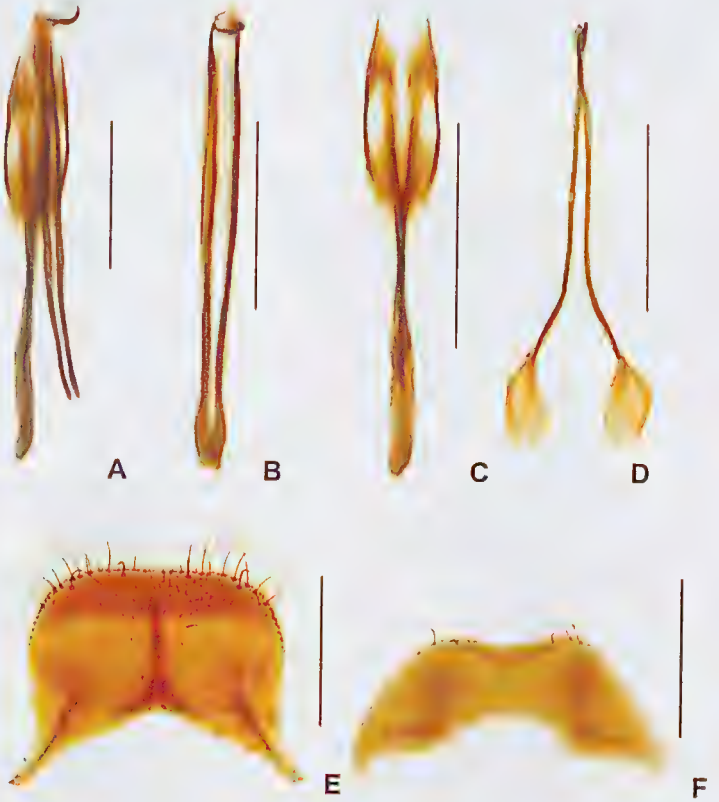


Fig. 7. *Kanaliella dregei.* (A) aedeagus ventral; (B) phallus ventral; (C) tegmen ventral; (D) spicular fork; (E) pygidium; (F) sixth ventrite (Scale bar 1 mm).

Kanaliella triangularis (Perroud, 1864), comb. n.

(Figs 6, 8, 10)

Natalis triangularis Perroud, 1864: 104; Fauvel 1904: 144.

Type material examined. Lectotype ♀ (designated here), NEW CALEDONIA: *triangularis* Perroud, Kanala, N. Caled.; ex coll. Perroud; type (MNHN). Paralectotype (designated here): Coll. R. I. Sc. N. B., Nouvelle Calédonie, Kanala, Janvier rec. Montrouzier, ex coll. Fauvel; det. Perroud 1864, *Natalis triangularis* Perr., ex coll. A. Fauvel; Syntype (ISNB).

Additional specimens. NEW CALEDONIA: Coll. R. I. Sc. N. B., Nouvelle Calédonie, Ile des Pins, rec. Deplanche, ex coll. Fauvel; coll. et det. A. Fauvel, *Natalis triangularis* Perr. R.I.Sc.N.B. 17.479 (ISNB). New Caledonia 12263, 21°34'S x 165°50'E Col d'Amieu, N waterfall 26Apr2005, GB Monteith beating, 270 m; *Eunatalis triangularis* (Perroud, 1864) Det. JS Bartlett, 2005 (QMB). 1 ♂, 1 ♀, Nouvelle-Calédonie, Farino/M. Barbou, Lat. S 21.61431 Long. E 165.70065 Alt. 408 m; Collecte sur: *S. gabriellae* Le 27/8/04 Par battage du piège Par S. Cazères (IAC). 2 ex. Nouvelle-Calédonie, Farino 3/Barbou L. Lat. S 21.63084 Long. E 165.70576 Alt. 315 m; Collecte sur: *S. gabriellae* Ralia Le 27/10/04 Par S. Cazères (IAC). 2 ♂♂, Nouvelle-Calédonie, Farino 7/Barbou L. Lat. S 21.63266 Long. E 165.70684 Alt. 263 m; Collecte sur: *S. gabriellae* Ralia Le 27/10/04 Par S. Cazères (IAC). 2 ex. Nouvelle-Calédonie, Farino/M. Barbou L. Lat. S 21.63084 Long. E 165.70576 Alt. 314 m; Collecte sur: *Schefflera gabriellae* Le 27/5/04 Par S. Cazères (IAC). 1 ♀, Nouvelle-Calédonie, Farino/M. Barbou L. Lat. S 21.63084 Long. E 165.70576 Alt. 314 m; Collecte sur: *Schefflera gabriellae* Le 09/6/04 Par S. Cazères (IAC). Nouvelle-Calédonie, Farino/M. Barbou L. Lat. S 21.63266 Long. E 165.70684 Alt. 263 m; Collecte sur: *Schefflera gabriellae* Le 16/7/04 Par S. Cazères (IAC). Nouvelle-Calédonie, Farino/M. Barbou, Lat. S 21.61431 Long. E 165.70065 Alt. 408 m; Collecte sur: *S. gabriellae* Le 09/9/04 Par battage du piège Par S. Cazères (IAC). 1 ♂, Nouvelle-Calédonie, Farino/Barbou sur *S. gabriellae* 23/06/04 S. Cazères coll. (IAC). Nouvelle-Calédonie, Poya/Beaupré, chez M. Dalstain 26/04/2007 S/C & J/P Coll. Battage B/cutting 4, S 21°28.634' E 165°11.237, Alt 12 (IAC). Nouvelle-Calédonie, SRFP 28 'Perroquet' Lat S 21.73393 Long. E 165.89605, alt. 23 m; Collecte sur: *Ficus* sp. 'Figuier' Piège par battage Le 05/01/05 Par S. Cazères (IAC).

Description. Length: 8.5-11.7 mm (18 specimens measured). Head: Black with light brown pilosity; with very dense large punctation and dense wrinkles; frons deeply sunken and bordered posteriorly by a triangular formation of golden setae, in the centre of the frons are further tuft-like formations of golden setae; eyes separated by about 2.1-2.33 eye widths.

Thorax: Pronotum dark reddish brown with dense light brown pilosity; conspicuously constricted behind apex and at base, widest behind middle; dense punctation and fine wrinkles; dorsal longitudinal fovea distinct; pronotum with four gibbosities; grooves of sub-basal collar separated by an indistinct bar; pronotal length to width ratio 1.12-1.22:1; scutellum triangular to circular, black with dense pilosity and punctation; thoracic ventrites light brown to dark brown with isolated whitish pilosity and isolated punctation; anterior mesoventral process not deepened.

Elytra: Elytral length to width ratio 2.59-2.69:1; elytra light brown to dark brown in basal half, in apical part yellow to light brown, with dense yellowish pilosity; elytra parallel to sub-parallel, elytral base slightly broader than pronotum; punctation irregular, punctation in basal half distinct and deep, becoming smaller towards apex, apical half with isolated punctation, diameter of punctures wider than interstices, punctation of ninth and tenth striae conspicuous towards apex; interstices with distinct microsculpture (wrinkles), interstices 3 and 5 ridged in basal half.

Legs: Brown to black-brown with dense, light brown pilosity, dense punctation and wrinkles; pro- and mesotibiae slightly bent.

Abdomen: Abdominal ventrites brown to black with a yellowish-coloured posterior margin; tegmen opened ventrally; phallic tip not Z-shaped; length of phallobase in relation to whole tegmen about 50%, lateral sclerotization of phallobase distinct, but not very strong, apical lateral sclerotization of parameres very weak, V-shaped branches of ventral sclerotization distinct, but not very strong; spicular fork fused less than one-fifth its length; sixth ventrite long more or less straight; pygidium compact, rounded, processes stout (Fig. 8).

Distribution. New Caledonia (including Isle of Pines and Lifou, after Fauvel 1904; Fig. 10).

Fig. 8. *Kanaliella triangularis.* (A) aedeagus ventral; (B) phallus ventral; (C) tegmen ventral; (D) spicular fork; (E) pygidium; (F) sixth ventrite (Scale bar 1 mm).

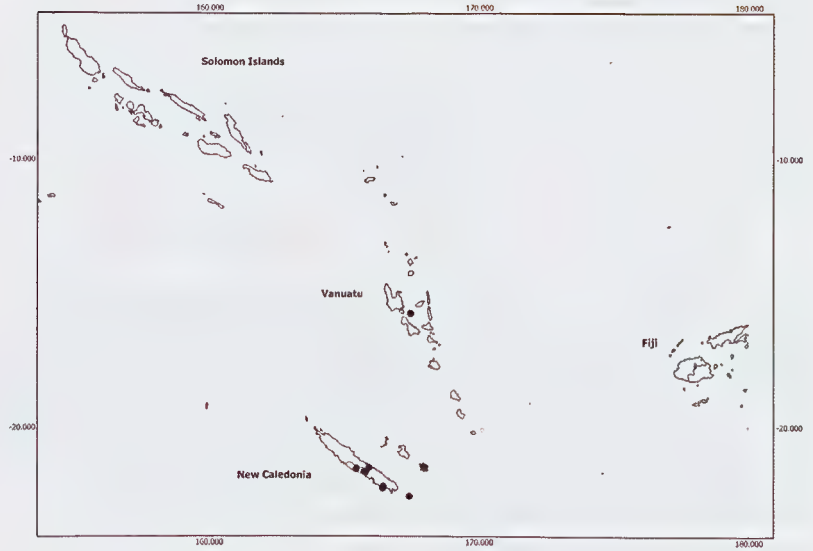


Fig. 9. Distribution map of *Kanaliella dregei.*

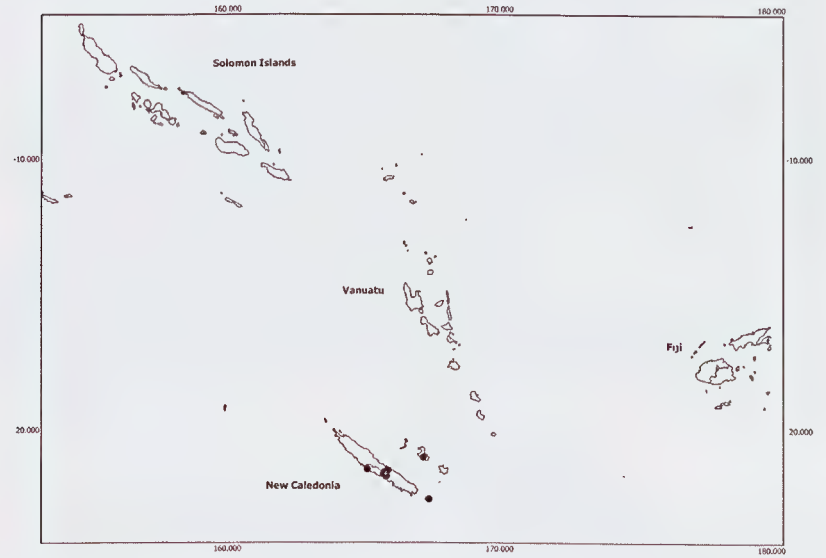


Fig. 10. Distribution map of *Kanaliella triangularis.*

Differential diagnosis

Kanaliella dregei is unmistakable by the slightly curved fascia of the elytra (which is densely vested with golden-yellow setae), the longitudinal fovea between the eyes, the longitudinal punctation behind the middle of elytra, fused grooves of the pronotal sub-basal collar and the straight mesotibiae.

Kanaliella triangularis has typical coloration and pilosity of the elytra, the pronotum is much longer than broad, the grooves of the pronotal sub-basal collar are separated by an indistinct bar and the mesotibiae are slightly bent.

Acknowledgements

We thank Thierry Deuve, Antoine Mantilleri (MNHN), Beulah Garner, Max Barclay (BMNH), Pol Limbourg (ISNB), Christian Mille (IAC), Susan Wright (QMSB), Lutz Behne, Stephan Blank (SDEI) and Otto Merkl (HNHM) for the loan of specimens, Marianne Müller (the senior author's wife) for her help with the photos and John M. Leavengood Jr. (Lexington, USA) and Justin S. Bartlett (Brisbane, Australia) for their profound revision of the manuscript. Sincere thanks to Justin Bartlett for providing us with the genitalia photos of *Kanaliella triangularis*.

References

FAUVEL, A. 1904. Faune analytique des coléoptères de la Nouvelle-Calédonie. *Revue d' Entomologie* **23**: 113-207.

GERSTMEIER, R. and SEITNER, M. 2013. Revision of the checkered beetle genus *Eunatalis* Schenkling, 1909 (Coleoptera: Cleridae, Clerinae). *Zootaxa*, in press.

KOLIBÁČ, J. 1998. Notes on the classification of *Natalis* Laporte de Castelnau and *Notocymatodera* Schenkling, with a description of *Notocymatodera disjuncta* sp. n. (Coleoptera: Cleridae). *Acta Musei Moraviae, Scientiae biologicae* **82**(1997): 191-198.

PERROUD, B.-P. 1864. Essai sur la faune entomologique de Kanala (Nouvelle-Calédonie) et description de quelques espèces nouvelles et peu connues. *Annales de la Societé Linnéenne de Lyon (n.s.)* **11**: 46-256.

SCHENKLING, S. 1909. Aus den Sitzungen. *Deutsche Entomologische Zeitschrift* **1909**: 162-163.

SOLERVICENS, J.A. 2007. Cladistic analysis of species of *Natalis* Laporte (1836) and related genera *Eunatalis* Schenkling (1909), *Metademius* Schenkling (1899) and *Eurymetomorphon* Pic (1950) (Coleoptera: Cleridae: Clerinae) with redescription of a restored Clerinae genus. *Zootaxa* **1398**: 1-14.

THE COURTSHIP BEHAVIOR OF THE BEE FLY *MEOMYIA VETUSTA* WALKER (DIPTERA: BOMBYLIIDAE)

D.J. FERGUSON and D.K. YEATES

Australian National Insect Collection, CSIRO Ecosystem Sciences, PO Box 1700, Canberra, ACT 2601

Abstract

Observations are provided on the courtship behaviour of *Meomyia vetusta* Walker in southeastern New South Wales, Australia.

Introduction

The Bombyliidae are a species rich, globally distributed group of brachyceran flies (Yeates 1994). Little is known of the life histories and behavioural biology of the Australian species, although there are many records of parasitism by non-Australian bombyliid larvae (Hull 1973, Yeates and Greathead 1997). Dodson and Yeates (1990) and Yeates and Dodson (1990) studied the territorial, hill-topping behaviour of male *Comptosia tutela* Yeates in southeastern Queensland. During these studies, a male was seen to intercept a female within a male territory, in mid-flight, achieving tail-to-tail copulation without displaying any overt courtship behaviour (Yeates and Dodson 1990). Toft (1989a, b) studied male *Lordotus pulchrissimus* Williston swarming behaviour and interactions with females in Californian sand dune environments; again courtship behaviour was not observed although the species copulates in mid air. Thus, bombyliid courtship behaviour, in territorial and swarming species at least, seems to consist of a simple mid-air intercept, grapple and copulation. This behavioural pattern is also common in many species of Lower Diptera such as Chironomidae, where the males form swarms and the females visit the swarms and copulate immediately with males in mid air (Downes 1969).

Colless (1977) observed a female *Anastoechus* sp. apparently displaying ovipositing behaviour on the floor of a sandstone overhang in the Bukalara Plateau, Northern Territory; however, this was most likely sand gathering rather than actual oviposition (Yeates 1994). One of us (DJF) observed the courtship behaviour of *Meomyia vetusta* Walker (Fig. 1) in sand dunes in southeastern New South Wales and this is reported here. To our knowledge, this species does not form hilltop aggregations, swarms or leks and the series of behaviours leading up to copulation is much more complex than previously reported for *Comptosia* or *Lordotus*.

The geographic distribution of *Meomyia vetusta,* determined from specimens in the Australian National Insect Collection (ANIC), is from southeastern Queensland to the Victorian border, mostly along the coast, with several specimens taken at higher altitudes along the Great Dividing Range. Adults fly from August to December in the northern part of the range and from October to December towards the southern end of the range.

Fig. 1. *Meomyia vetusta* (ANIC_29:029405) female, collected on the same day at the same location as the observations reported here. Scale = 5 mm.

Observations

Observations were made in a sand dune environment adjacent to Broulee Island, southeastern New South Wales (35°51'S 150°10'E), on the morning of 1 October 2012. Weather conditions were calm, 15°C at 0900h and under a cloudless sky.

The first courtship observation was at approximately 0930h and was detected through a loud buzzing noise produced by the male, which was hovering just in front of a motionless female resting on the tip of a leaf of *Lomandra longifolia* (Xanthorrhoeaceae). The male was slowly hovering in an arc of approximately 45° directly in front of the female and in the same horizontal plane. The male was also actively touching the female's proboscis with his throughout this hovering flight behaviour. After approximately 90 seconds the female took flight, when the male intercepted and grappled with her in mid air, achieving a tail-to-tail copulating position before the pair flew away. Both male and female were netted and vouchered in ANIC.

The second observation occurred at around 1000h, when a female, flying slowly approximately 30 cm above the ground, passed over a resting male. The male immediately flew rapidly to intercept the female, bumped into her, then dropped below and behind her, keeping a distance of about 15 cm. The male followed the female for about 20 m until she landed on the end of an *L. longifolia* leaf. Consistent with the previous observation, the male then produced a loud buzzing sound, which was louder and of a different pitch to the sound produced when flying normally. This loud buzzing sound was produced while the male hovered left and right of the motionless female in an

arc of approximately 45°, and while the male actively touched his proboscis against the female's. This continued for approximately a minute, until the female took flight, when the male then intercepted and grappled with the female, achieving a tail-to-tail copulation in mid air. The pair then flew a short distance away before landing and remaining in copula.

Discussion

The two observed courtships, involving different pairs, were consistent and suggest the following series of six behaviours, by both male and female, leading to copulation in *Meomyia vetusta*:

1. The female flies slowly near the ground in the vicinity of the resting male.

2. Once within range, the male intercepts the female in flight and grapples with her.

3. The female continues flying while the male drops to a position behind and below the female, separated by a distance of approximately 15 cm.

4. The pair fly in unison for a few metres, then the female lands while the male hovers directly in front of her.

5. The male touches the female's proboscis with his proboscis, while slowly hovering in an arc of approximately 45° directly in front of the female in the same horizontal plane. The female remains motionless during this stage. While hovering, the male also produces a distinct, loud, buzzing sound with his wings. This stage lasts 60-90 seconds.

6. The pair fly upwards, the male intercepts the female and grapples with her before quickly achieving a tail-to-tail copulation position, the pair then flying briefly together before landing to remain in copula.

Stage 5 is clearly the most complex and unusual and not previously described in Diptera. No fluid transfer or nuptial gifting was observed between the sexes during this stage, but remains a possibility and does occur in other flies (Marshall 2012). The mechanism of sound production during stage 5 is unknown, but presumably involves a change in the attitude of the wings as the insect hovers. The series of behaviours elicited by both sexes leading up to copulation in *Meomyia vetusta* shows that the courtship behaviour of bee fly species that do not swarm or lek may be very complex.

Acknowledgement

We thank Cate Lemann, CSIRO Ecosystem Sciences for the photograph.

References

COLLESS, D.H. 1977. A note on apparent oviposition in a bombyliid fly (Diptera). *Australian Entomological Magazine* **3**(5): 90-91.

DODSON, G.N. and YEATES, D.K. 1990. The mating system of a beefly (Diptera, Bombyliidae) II. Factors affecting male territorial and mating success. *Journal of Insect Behaviour* **3**: 619-636.

DOWNES, J.A. 1969. Swarming and mating flight of Diptera. *Annual Review of Entomology* **14**: 271-293.

HULL, F.M. 1973. *Bee flies of the World.* Smithsonian Institution Press; 687 pp.

MARSHALL, S.A. 2012. *Flies: the natural history and diversity of Diptera.* Firefly Press, Ontario; 616 pp.

ROBERTS, F.H.S. 1928-29. A revision of the Australian Bombyliidae (Diptera). Parts 1-111. *Proceedings of the Linnean Society of New South Wales* **53**: 90-144, 413-55 (1928); **54**: 553-83 (1929).

TOFT, C.A. 1989a. Population structure and mating system of a desert bee fly (*Lordotus pulchrissimus*; Diptera: Bombyliidae). 1. Male demography and interactions. *Oikos* **54**: 345-358.

TOFT, C.A. 1989b. Population structure and mating system of a desert bee fly (*Lordotus pulchrissimus*; Diptera: Bombyliidae). 2. Female demography, copulations and characteristics of swarm sites. *Oikos* **54**: 359-369.

YEATES, D.K. and DODSON, G. 1990. The mating system of a beefly (Diptera, Bombyliidae). I. Non-resource-based hilltop territoriality and a resource-based alternative. *Journal of Insect Behaviour* **3**: 603-617.

YEATES, D.K. and GREATHEAD, D. 1997. The evolutionary pattern of host use in the Bombyliidae (Diptera): a diverse family of parasitoid flies. *Biological Journal of the Linnean Society* **60**: 149-185, 5 figs.

THEMARA MACULIPENNIS (WESTWOOD) AND *THEMARA HIRTIPES* RONDANI (DIPTERA: TEPHRITIDAE: ACANTHONEVRINI): A CASE OF CONFUSED SYNONYMIES

DAVID L. HANCOCK

8/3 McPherson Close, Edge Hill, Cairns, Qld 4870

Abstract

Two species of the Oriental genus *Themara* Walker, *viz. T. maculipennis* (Westwood) and *T. hirtipes* Rondani, are discussed, with *T, enderleini* Hering removed from synonymy with *T. hirtipes* and placed as a new synonym of *T. maculipennis*, while *Themara montina* Enderlein is removed from synonymy with *T. maculipennis* and placed as a new synonym of *T. hirtipes*. Lectotypes for *T. maculipennis* and *T. enderleini* are designated. A note on biology is included.

Introduction

During a recent examination of *Themara* Walker specimens in the Natural History Museum, London, it became clear that the synonymies in *T. maculipennis* (Westwood) and *T. hirtipes* Rondani had become confused. This is due to an undue reliance being placed on the presence or absence of a dark medial vitta on the scutum for assigning specimens to one species or the other (*e.g.* Perkins 1938, Hardy 1974, 1986). It is now known that this character is intraspecifically variable (Hancock 2011), with the extent of curvature in vein R_{2+3} in males being far more reliable as a specific character.

Themara yunnana Zia, previously placed as a synonym of *T. hirtipes* (*e.g.* Hardy 1974, 1986, Hancock and Drew 1994), was shown to be a distinct species by Hancock (2011). Two other cases of misplaced synonyms are discussed here. Since the type series of one of these synonyms, *T. enderleini* Hering, appears to be a mix of three separate species, a lectotype is designated so that it may be properly defined. A lectotype is also designated for *T. maculipennis* (Westwood) so that it, too, becomes taxonomically fixed. Since biological studies are being undertaken on these species (*e.g.* Burkhardt and de la Motte 1994, 1996), it is essential that they are properly identified.

The following abbreviations have been used for specimen depositories: BMNH – The Natural History Museum, London; DEI – Senckenberg Deutsches Entomologisches Institut; MCSNG – Museo Civico di Storia Naturale "Giacomo Doria", Genoa; OUMNH – Oxford University Museum of Natural History, Oxford; PAN – Polish Academy of Science Museum of the Institute of Zoology, Warsaw; QDPI – Queensland Department of Agriculture, Forestry and Fisheries, Brisbane; ZMHU – Museum für Naturkunde, Berlin.

Systematics

Themara maculipennis (Westwood)

(Figs 1-3)

Achias maculipennis Westwood, 1847: 38, pl. 18 fig. 4. Type locality Java, Indonesia. Lectotype ♂ in BMNH, here designated; examined.

Achias horsfieldii Westwood, 1850: 235, pl. 23 fig. 9. Type locality Java, Indonesia. Lectotype ♂ in BMNH, designated by Hardy (1969); examined.

Acanthoneura maculipennis: Enderlein, 1911: 415 [*partim*]. Soekeranda and Liangagas, Sumatra, Indonesia.

Themara enderleini Hering, 1938: 409. Type locality Liangagas, Sumatra, Indonesia. Lectotype ♂ in BMNH; here designated; examined. **Syn. n.**

Material examined. INDONESIA: Lectotype ♂ of *Achias maculipennis* [labelled HT], Java (BMNH); 1 ♂ paralectotype [labelled ST], Java (BMNH); 1 ♂ paralectotype, 'W' [ex Westwood Collection], no data (OUMNH); Lectotype ♂ and 1 ♂, 1 ♀ paralectotypes of *Achias horsfieldii*, Java (BMNH); 4 ♂♂, 2 ♀♀, West Java (BMNH); Lectotype ♂ of *Themara enderleini* [labelled PT], Liangagas, Sumatra, Dohrn (also labelled '*Themara enderleini*, PT, det. M. Hering 1937' / 'Purch. from E.M. Hering, B.M. 1965-270') (BMNH); 1 ♂, West Sumatra (BMNH); 1 ♂, Padang, Sumatra (BMNH); 1 ♂, Lebang Tandal, West Sumatra (BMNH). SINGAPORE: 1 ♂, Singapore, 1867 (OUMNH); 1 ♂, Singapore (BMNH). WEST MALAYSIA: 1 ♂, 1 ♀, Ulu Gombak, Serdang, 25.iii.1988, I.M. White & Ooi, C.S. (BMNH).

Notes. *Themara enderleini* was placed in synonymy with *T. hirtipes* by Hardy (1974) but Enderlein's (1911) series, removed from *T. maculipennis* and renamed by Hering (1938), is clearly mixed, containing representatives of *T. maculipennis*, *T. hirtipes* (a female with the hyaline indentation in cell m narrow – presumably the specimen referred to *T. hirtipes* below) and *T. ampla* Walker (a female with no hyaline spot in cell r_{4+5} near the DM-Cu crossvein). Enderlein (1911) noted the range of variation and had included *T. ampla* within the synonymy of *T. maculipennis*. Hering (1938) referred to a 'Type ♂', a 'Type ♀' and several other specimens; these are thus all of syntype status. The location of most of this material is uncertain (Norrbom *et al.* 1999). Hering (1938) stated 'Stettiner Museum' [now PAN], whereas Hardy (1974) recorded the 'Type ♂' as in DEI. One pair of STs, however, is in BMNH (from Hering's personal collection) so it is evident that not all, if any, of the specimens examined by Hering were returned to PAN [the intervention of World War II might have prevented this]. In order to stabilise the name and prevent further confusion, a lectotype is designated. The male in BMNH (Fig. 1), although labelled PT, is selected since (a) it bears Hering's determination label and was definitely seen by him; (b) its location is known; and (c) it is readily comparable with the lectotypes of *T. maculipennis* and *T. horsfieldii*, both also in BMNH.

In order to maintain stability of the name *T. maculipennis*, a lectotype is also designated for that species. Three syntype males are present in BMNH and OUMNH, the specimen selected being the male in BMNH labelled 'HT'.

Perkins (1938) also illustrated the male wing. The wing of a Javan female attributed to this species is provided here (Fig. 2). The above specimens from West Malaysia (Fig. 3) are smaller than typical specimens and the male has a correspondingly narrower head but they otherwise appear to belong to *T. maculipennis* and are included here.

Figs 1-3. *Themara maculipennis*. (1) Lectotype male of the synonym *T. enderleini* from Sumatra; (2) wing of female from West Java; (3) male and female from West Malaysia. Photos by K. Goodger © Natural History Museum, London.

This species may be separated from *T. hirtipes* by the more distinctly undulate and curved vein R_{2+3}, especially in males (where it meets the costa before the mid point between veins R_1 and R_{4+5}), the broader hyaline indentation in cell m and the generally shorter and thicker 'eye stalks' in males. From *T. ampla* it differs in the presence of the male 'eye stalks' and better developed hyaline spot in cell r_{4+5} near the DM-Cu crossvein. The dark medial vitta on the scutum is often indistinct. In the otherwise similar Indo-Chinese species *T. yunnana*, the male head is broad but not produced into distinct 'eye stalks' (Hancock 2011, David and Ramani 2011).

T. maculipennis is known from Java, Sumatra, Singapore and West Malaysia.

Themara hirtipes Rondani

Achias maculipennis: Walker, 1856: 134. Sarawak, Malaysia. Misidentification.

Themara hirtipes Rondani, 1875: 435. Type locality Sarawak, Malaysia. Type ♂ in MCSNG; not examined.

Acanthoneura maculipennis: Enderlein, 1911: 415 [*partim*]. Soekeranda, Sumatra, Indonesia. Misidentification.

Acanthoneura montina Enderlein, 1911: 416. Type locality Mt Gede, west Java, Indonesia. Holotype ♂ in PAN; not examined. **Syn. n.**

Themara enderleini: Hering, 1938: 409 [*partim*]. Soekeranda, Sumatra, Indonesia. Misidentification.

Themara palawanica Hering, 1938: 410, fig. 2. Type locality Binaluan, Palawan, Philippines. Holotype ♂ in ZMHU; not examined. Synonymised by Hardy (1974).

Themara maculipennis: Hardy, 1986: 141 [*partim*]. Sabah, Malaysia. Misidentification.

Themara maculipennis: Hancock & Drew, 1994: 564. Sarawak, Malaysia. Misidentification.

Themara maculipennis: Chua, 2002: 46. Brunei. Misidentification.

Material examined. INDONESIA: 1 ♀ [labelled PT of *Themara enderleini*], Soekeranda, Sumatra, Dohrn (BMNH). EAST MALAYSIA: 17 ♂♂, Kuching, Sarawak (OUMNH); 1 ♂, Tarat Agric. Station, near Kuching, Sarawak, 10.viii.1992, S. Leong (QDPI); 2 ♂♂, Sg. Poyan, Limbang, Sarawak, vi.1993, S. Leong (QDPI). Several additional specimens from Sarawak, of both sexes, in BMNH.

Notes. Acanthoneura montina was placed in synonymy with *T. maculipennis* by Hardy (1986) but Enderlein's (1911) description indicates a very broad head and states 'r_{2+3} endet sehr wenig ausserhalb der Mitte zwischen r_1 und r_{4+5}' (vein R_{2+3} ends a little outside [beyond] the mid point between veins R_1 and R_{4+5}), thus indicating a weakly undulate vein that does not curve sharply towards the costa. The synonymy of *T. palawanica* is evident from Hering's (1938) description and illustration. At least one specimen from Enderlein's (1911) series (the 'PT' of *T. enderleini* from Soekeranda, Sumatra noted above) appears to belong to *T. hirtipes*. A third species included in the synonymy of *T. hirtipes* by Hardy (1974), *T. yunnana* Zia, was shown to be a distinct species by Hancock (2011) and removed.

This species was illustrated by Perkins (1938), Hancock and Drew (1994, as *T. maculipennis*) and Hancock (2011). It differs from both *T. maculipennis* and *T. ampla* in the less undulate vein R_{2+3} in both sexes, the narrower hyaline indentation in cell m and the generally more elongate and slender 'eye stalks' in males. The dark medial vitta on the scutum may be present or absent and the amount of black on the scutellum is variable in extent.

T. hirtipes has been recorded from southeast China (Hainan), Laos, Thailand, southern Burma, Sumatra, Java, West Malaysia, Sarawak, Sabah, Brunei and Palawan. The note following the Singapore record of *T. maculipennis* in Hardy (1986) possibly refers to one of the other listed specimens.

Biology

Perkins (1938) recorded specimens of *Themara hirtipes* collected on the bark of felled trees in old secondary forest in Sarawak, Malaysia and this species is now known to breed in rotting logs, with females ovipositing in holes made by bark beetles or other insects (Burkhardt and de la Motte 1994, 1996). Perkins (1938) also recorded specimens of *T. hirsuta* (Perkins) on bark of felled trees and it is likely that all species of *Themara* breed in rotting logs. It is also likely that the closely related genera *Acanthonevra* Macquart (as restricted by Hancock 2011, 2012b), *Chaetomerella* de Meijere and *Freyomyia* Hardy also utilise this host. A presumed association with bamboo (Hancock 2011) for these genera is likely to be no more than casual, whereas other genera in the *Acanthonevra* complex, such as *Ptilona* van der Wulp and *Rioxoptilona* Hendel, breed in dead bamboo culms or decaying bamboo shoots respectively (Hancock 2011).

The breeding biology of *Themara* is very similar to that of *Rioxa sexmaculata* (van der Wulp) [a species in the related *Rioxa* complex], which also oviposits in holes made by bark beetles or other insects in rotting logs (Kovac *et al.* 2010) and log-breeding might be a basal character in the *Acanthonevra* complex, with utilisation of decaying bamboo a secondary characteristic (and possibly independently derived in *Ptilona* and *Rioxoptilona*, which use different parts of the bamboo plant). In the similarly related *Sophira* complex, it appears to be living bamboo stems and older shoots that are utilised (Hancock 2012a).

Acknowledgements

I thank Kim Goodger (BMNH) and James Hogan (OUMNH) for the photographs and/or access to specimens in their care. Damir Kovac (Forschungsinstitut Senckenberg, Frankfurt am Main) kindly brought the studies on *Themara* biology to my attention and supplied a copy of his paper.

References

BURKHARDT, D. and de la MOTTE, I. 1994. Tephritid flies. In: Earl of Cranbrook and Edwards, D.S. (eds), *A tropical rainforest. The nature of biodiversity in Borneo at Belalong, Brunei.* The Royal Geographical Society and Sun Tree Publishing, Singapore; 389 pp.

BURKHARDT, D. and de la MOTTE, I. 1996. Stalk-eyed flies: caprices of evolution? Pp 169-174, in: Edwards, D.S., Booth, W.E. and Choy, S.C. (eds), *Tropical rainforest research – current issues.* Monographie Biologicae 74. Kluwer Academic Publishers; 566 pp.

CHUA, T.H. 2002. New records of Trypetinae from Brunei Darussalam (Diptera: Tephritidae). *Malayan Nature Journal* **56**(1): 43-48.

DAVID, K.J. and RAMANI, S. 2011. An illustrated key to the fruit flies (Diptera: Tephritidae) from peninsular India and the Andaman and Nicobar Islands. *Zootaxa* **3021**: 1-31.

ENDERLEIN, G. 1911. Trypetiden-Studien. *Zoologische Jahrbucher. Abteilung für Systematik, Oekologie und Geographie der Tierre* **31**: 407-460.

HANCOCK, D.L. 2011. An annotated key to the species of *Acanthonevra* Macquart and allied genera (Diptera: Tephritidae: Acanthonevrini). *Australian Entomologist* **38**(3): 109-128.

HANCOCK, D.L. 2012a. Bamboo-stem flies: an annotated key to the species of the *Sophira* complex of genera (Diptera: Tephritidae: Acanthonevrini). *Australian Entomologist* **39**(1): 5-32.

HANCOCK, D.L. 2012b. A note on the identity of '*Acanthonevra*' *inermis* Hering (Diptera: Tephritidae: Acanthonevrini). *Australian Entomologist* **39**(3): 195-196.

HANCOCK, D.L. and DREW, R.A.I. 1994. New species and records of Asian Trypetidae (Diptera: Tephritidae). *Raffles Bulletin of Zoology* **42**(3): 555-591.

HARDY, D.E. 1969. Lectotype designations for fruit flies (Diptera: Tephritidae). *Pacific Insects* **11**: 477-481.

HARDY, D.E. 1974. The fruit flies of the Philippines (Diptera: Tephritidae). *Pacific Insects Monograph* **32**: 1-266, 6 pls.

HARDY, D.E. 1986. Fruit flies of the subtribe Acanthonevrina of Indonesia, New Guinea, and the Bismarck and Solomon Islands (Diptera: Tephritidae: Trypetinae: Acanthonevrini). *Pacific Insects Monograph* **42**: 1-191.

HERING, [E].M. 1938. Neue palaearktische und exotische Bohrfliegen. *Deutsche Entomologische Zeitschrift* **1938**: 397-417.

KOVAC, D., DOHM, P. and FREIDBERG, A. 2010. Field observations on the mating behaviour of the Oriental *Rioxa sexmaculata* (van der Wulp) (Diptera: Tephritidae) and a review of the reproductive behaviour patterns in Acanthonevrini. *Biosystematica* **4**(1): 5-14.

NORRBOM, A.L., CARROLL, L.E., THOMPSON, F.C., WHITE, I.M. and FREIDBERG, A. 1999. Systematic database of names. Pp 65-251, in: Thompson, F.C. (ed.), Fruit fly expert identification system and systematic information database. *Myia* **9**: ix + 524 pp.

PERKINS, F.A. 1938. Results of the Oxford University Expedition to Sarawak (Borneo), 1932. Diptera, Trypetidae. *Annals and Magazine of Natural History* (11) **2**: 401-409, pl. xv.

RONDANI, C. 1875. Muscaria exotica Musei Civici Januensis. Fragmentum III. Species in Insula Bonae fortunae (Borneo), Provincia Sarawak, annis 1865-1868 lectae a March. J. Doria et Doct. O. Beccari. *Annali del Museo Civico di Storia Naturale, Genova* **7**: 421-464.

WALKER, F. 1856. Catalogue of the dipterous insects collected at Sarawak, Borneo, by Mr. A. R. Wallace, with descriptions of new species. *Journal of Proceedings of the Linnean Society of London, Zoology* (1857) **1**: 105-136.

WESTWOOD, J.O. 1847. Diptera. Pp 37-38, pl. 18, in: *The cabinet of Oriental Entomology*. W. Smith, London; 2 + 2 + 88 pp (1848).

WESTWOOD, J.O. 1850. Diptera nonnulla exotica descripta. *Transactions of the Entomological Society of London* (1849) **5**: 231-236, pl. xxiii.

FURTHER AUSTRALIAN LOCALITY DATA FOR *CTENOLEPISMA ROTHSCHILDI* SILVESTRI (ZYGENTOMA: LEPISMATIDAE)

GRAEME SMITH[1] and JOHN IRISH[2]

[1]*246 Alfred St, Narraweena, NSW 2099 (Email: le_gbsmith@optusnet.com.au)*

[2]*PO Box 30061, Windhoek, Namibia (Email: jirish@mweb.com.na)*

Abstract

Further locality records for *Ctenolepisma rothschildi* Silvestri are given, confirming its presence in Australia since at least 1960.

Introduction

Smith (2012) reported the presence of this semi-cosmopolitan silverfish species at Longreach in Queensland and used that material to redescribe the species according to current criteria. Although not previously reported in the literature, its presence at a relatively remote inland town suggested it had been in Australia for some time.

Recently, one of us (GS) became aware of older material in the Australian National Insect Collection (ANIC), which had been identified by the other (JI) as *Ctenolepisma rothschildi* Silvestri. Contact was established and JI provided details of this and other material of *C. rothschildi* examined from the Museum and Art Galleries of the Northern Territory (NTM) and the Entomology Department of the University of Queensland (EUQ), which confirms the species' presence in Australia since at least 1960. This short note records the material determined by JI from Queensland, the Northern Territory and Western Australia. EUQ material is now housed in the Queensland Museum, Brisbane.

New records

Family Lepismatidae Latreille

Ctenolepisma rothschildi Silvestri, 1907

Material examined. QUEENSLAND: 2 ♀♀, 1 ♂, Ingham Res. Station, 13.iv.1960, K.L.S. Harley (EUQ); 1 ♀, Townsville Common, base of *A. laurensis* mound, 25.vii.1966, F.J. Gay (with two specimens of *Lepisma* sp. *(sensu lato)*) (ANIC). NORTHERN TERRITORY: 1 ♂, Darwin, August 1983, M. Malipatil (NTM); 1 ♀, Darwin, 30.iv.1985, M.B. Malipatil (NTM); 1 ♀, Darwin, August 1988, M.B. Malipatil (NTM); 1 ♀, Howard Springs, 2 km down Virginia Rd, 9.ix.1990, K. Coombes (NTM); 1 unsexed in many pieces, Radon Ck, WL PT A/3, 8.viii.1975 (NTM). WESTERN AUSTRALIA: 2 ♀♀, 1 ♂, 2 unsexed, Camballin, 5.iii.1968, J.A.L. Watson (ANIC).

Conclusion

These records confirm that *Ctenolepisma rothschildi* has been present in Australia since at least 1960 and has since been found at a wide range of locations across the tropical northern region. Many of these locations are hundreds of kilometres from any port and in lightly populated areas,

suggesting that the species has become established in northern Australia and is now widespread. Due to limited efforts to collect silverfish in much of Australia, no comment can be made as to its abundance.

Acknowledgments

We thank Drs M. Schneider, A. Wells and the late J.A.L. Watson for arranging the loan of this material to JI from EUQ, NTM and ANIC respectively.

Reference

SMITH, G. 2012. *Ctenolepisma rothschildi* Silvestri (Zygentoma: Lepismatidae) in Australia. *Australian Entomologist* **39**(1): 39-47.

ENTOMOLOGICAL NOTICES

Items for insertion should be sent to the business manager who reserves the right to alter, reject or charge for notices.

NOTES FOR AUTHORS

Manuscripts submitted for publication can be submitted as either hardcopies or electronically. Three copies (double spaced text and illustrations) of hardcopy manuscripts should be submitted. Manuscripts submitted in digital format should be sent in Microsoft Word. Digital illustrations should be sent initially as low resolution images in a separate Word file, as low resolution JPEGs, or as low resolution PDF files, with figure numbers indicated clearly for each figure. High resolution TIFFs or JPEGs (300 dpi at print size) must be provided at the time of acceptance of the manuscript. Digital manuscripts may be sent via email to federica.turco@qm.qld.gov.au Hardcopy manuscripts and digital manuscripts on disc should be sent to:

The Editorial Co-ordinator
The Australian Entomologist
P.O. Box 537,
Indooroopilly, Qld, 4068

Authors should refer to recent issues for layout and style. All papers will be forwarded to two referees and the editor reserves the right to reject any paper considered unsuitable.

It is editorial policy that usage of taxonomic nomenclature will comply with the mandatory provisions of the International Code of Zoological Nomenclature.

Publication costs are $10 per page up to 20 pages, and $20 per page in excess of 20. This covers unlimited use of colour which is encouraged. These costs include the supply of a pdf copy of the paper and 10 hardcopy reprints to the senior author. Papers occupying one printed page or less may be accepted without charge if no reprints are required. Reprints may be supplied for one page papers at the normal cost, by arrangement. Page charges may be reduced at the discretion of the Publications Committee. An application for reduction must be made, with reasons, at the time of acceptance of the manuscript.

Further information for authors is given on the ESQ website at http://www.esq.org.au/Authors%20guide%201.html

Printed by Bayfield Printing, Unit 6/60 Kremzow Rd, Brendale, Q 4500, Ph: 1300 685 820

THE AUSTRALIAN
Entomologist

Volume 40, Part 2, 21 May 2013

CONTENTS

BARTLETT, J.S. AND SZITO, A.
Opetiopalpus scutellaris Panzer (Coleoptera: Cleridae: Korynetinae) established in the Western Australian wheatbelt
65

FERGUSON, D.J. AND YEATES, D.K.
The courtship behavior of the bee fly *Meomyia vetusta* Walker (Diptera: Bombyliidae)
89

GERSTMEIER, R. AND SEITNER, M.
Kanaliella gen. n., a new genus of Cleridae from the Melanesian region (Coleoptera: Cleridae: Clerinae)
79

HANCOCK, D.L.
Themara maculipennis (Westwood) and *Themara hirtipes* Rondani (Diptera: Tephritidae: Acanthonevrini): a case of confused synonymies
93

HOUSTON, T.F. AND PIKE, D.T.
Aerial brood cells constructed by some Australian Resin Bees (Hymenoptera: Megachilidae) and a case of gregarious nesting
67

MARINOV, M. AND RICHARDS, S.
Notes on the female colour forms of *Synthemis miranda* Selys, 1871 (Odonata: Synthemistidae) in New Caledonia
57

SMITH, G. AND IRISH, J.
Further Australian locality data for *Ctenolepisma rothschildi* Silvestri (Zygentoma: Lepismatidae)
99

ISSN 1320 6133